THE JOURNAL

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PROCEEDINGS AND INDEX

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PROCEEDINGS—NAME INDEX

In this Index (C) indicates that the matter is the subject of a Communication, and (R) that the matter is a Review.

PROCEEDINGS—SUBJECT INDEX

THE JOURNAL OF THE
TEXTILE INSTITUTE

Vol. XVII JANUARY 1926 No. 1

PROCEEDINGS

Lancashire Section

Luncheon meeting at the Institute, 4th December 1925, *the late Professor W. Myers being in the chair.*

RESEARCH AND MILL PERSONNEL

By Dr. J. C. Withers

I suppose it was inevitable that in the interesting course of mid-day conferences on factors which directly concern mill personnel, research should have been chosen as a subject for discussion. Why I should have been invited to take this particular topic is to me by no means so obvious, and I am not a little embarrassed to think I was rash enough to respond. Many here will expect me, perhaps, to deal with results which have been obtained by the Textile Research Associations, particularly that for the cotton industry, with which I am connected, and say how I imagine they may affect the staffing of mills and the welfare of the operatives; but I wish to speak to-day as a private member of the Textile Institute, and treat my subject in a broader way. In the first place, I want to attempt some explanation of what research *is*, and what are its results. My suspicion is that a good many persons in the textile industry regard it as a kind of magic worked in laboratories by "scientists." Research is not a magic, but a method or discipline. It consists in attacking problems by scientific method, which I would sum up in the words—*Prove all things; prove them one at a time*. First, the problem must be stated, and in many branches of the textile industry this is by no means easy. Then the causes which can make for different effects must be defined, and, finally, when studying one property, only one governing factor at a time must be allowed to vary unless the effects of other factors are so well proved that due corrections can be applied for them. For example, when comparing the spinning properties of two cottons, they must go through exactly the same opening treatments; when comparing two yarns, the testing conditions must be exactly the same; and when comparing similar processes or the effects of atmospheric and other conditions, the materials examined must be the same. Now what are the results of research? These can be divided usually into two groups—new facts about things, and new methods or processes.

Let me now give some examples of statements which are all too common in the textile literature to illustrate real deficiencies of research spirit or scientific method.

(1) In the production of yarns, there are the perennial debates, for example, as to the damage done by various opening processes, and as to whether the twist in ring yarns is inserted by the spindle or the traveller. Could not these questions be settled by experiment ?

(2) Sizing. An English authority declares that less than 8% of zinc chloride does more harm than good, whilst an American says 1% is adequate to prevent mildew. Are both correct ? Is the American letting his cloth reach the moisture regain which the English writer employs ?

(3) Again on sizing. Nearly all the books speak of the grave danger of tendering during singeing when certain chlorides are used in the size. This is said to be due to liberation of hydrochloric acid, but many authorities deny that the small quantities of chlorides present could, at the temperature employed, and in the brief time of action, give sufficient hydrochloric acid to cause any damage. What is the truth about this chloride "scare" ?

(4) A French authority has recently described an interesting case of supposed tendering of cloth when left in the hot drying-room above the calico printing machine. To his surprise, the cloth proved to be sound after conditioning. He had therefore an excellent opportunity to study the effect of temperature and humidity as factors influencing the strength of a fabric—a most interesting problem—and he performed some tests with his testing machine in the hot room. Unfortunately, the figures he publishes compare the breaking load of cloth at 85° C. and absolute dryness with the same at 4° C. and atmospheric humidity—*two* factors changed at a time instead of one. This renders his figures practically valueless.

So, coming to my argument, the first point I wish to make is that a study of the principles of research will show that there is a wide possibility for men in responsible positions in mills to become themselves real research workers. Many problems can be solved under works conditions if those in control will, to quote Huxley's letter to Charles Kingsley—"Sit down before fact as a little child, be prepared to give up every preconceived notion, and follow humbly wherever and to whatever abysses Nature leads."

It is generally recognised, however, that the solution of numerous trade problems demands such searching after fundamental facts with the aid of superior equipment that the establishment of centralised Industrial Research Institutes has been wise. Having discovered facts through the application of these unrivalled resources, the next step is to utilise them, and this is obviously where mill men are concerned. May I venture to assert that it is the *duty* of the practical man to endeavour to apply them. Discovered facts, rightly applied, inevitably make for better control of processes, which means quicker adaptation to new requirements than is achieved by relying solely on experience, and fewer faults. Surely these are desirable attainments in practice; and it would pay in the long run even supposing the mill should find it necessary to employ men trained in scientific method to interpret the results of research.

It is well known that many fundamental discoveries in science have required long and costly trials before they have been successfully woven into large scale practice. We have been reminded recently, for example, that the experimental work required for the development of the synthesis of Indigo into a successful commercial venture cost over one million pounds and twenty years of hard work. I am confident, however, that the textile industries will see a much more rapid application of the knowledge gained in their research institutes. Taking cotton, for example, I think it may rightly be claimed that the results of tests made in the Shirley Institute on high draft systems have already inspired confidence in a method of spinning to which Lancashire was averse, but which is bound to affect profoundly future lay-outs of mills. This confidence is reflected in the very rapid application of Lancashire brains to invention in this field, particularly during the past two years. Another group of researches at the Shirley Institute

which will, I think, find immediate application is that into the effect of over-bleaching on the properties of cotton cellulose. Methods have been described by which bleached cloth can be tested for the permanence of white or level dyeing qualities, and by which tendering can be detected in incipient stages. It has also been shown that many faults in bleaching, especially of goods with coloured stripes &c., are due to fluctuations in the degree of acidity or alkalinity of the chemic over a very small range, and that a great element of risk would therefore be avoided if means were available for checking the chemic periodically. These tests for bleaching efficiency and for controlling the chemic are well within the scope of a competent chemist, and it would seem therefore that at no distant date an efficient bleachery will add them to the routine of the works laboratory.

It is also significant, I think, that many recent discoveries in the field of finishing processes are based on conditions which are only secured within very narrow limits, demanding, therefore, rigid and expert control.

I now come to what may be, in some respects, the less obvious part of my argument, namely, the effect of the discovery of proved facts on the rank and file operative. I must decline to take up the question of possible effects on labour through the elimination of unnecessary processes or the betterment of working conditions, partly because these are so obvious and partly because they are controversial subjects. I want to state, however, that it is my conviction that greater knowledge about the properties of the things handled and the mechanism of the processes applied to them—the knowledge provided through research—will make for more interested, alert, and keen workpeople. Those of us who are new to Lancashire are astonished at the keenness for information on the part of those in the main body of the textile army, as revealed by their very numerous societies for the hearing of lectures and holding of technical discussions, and their appreciation when visiting our research laboratories. In my view this keenness is an invaluable asset to Lancashire. It should be fostered by bringing to the rank and file, as widely as possible, the results of scientific study. By feeding the desire for knowledge in this way, those "pessimistic reveries," to use the psychologist's term, which make for spoilt work and personal injuries will be greatly diminished.

Discussion

Mr. F. P. Slater said that Dr. Withers had stated very clearly what he considered was scientific method, but unfortunately in the past the Shirley Institute had at times been guilty of not carrying out the principles enunciated. Speaking as a scientist himself, he felt that research workers had only themselves to blame for a great deal of the mistrust with which the practical man regarded them. Much of the literature published with regard to research work would probably prove to be of ephemeral value, and it would be far better to wait until something really tangible and useful could be demonstrated before resorting to the letterpress. The suggestion to conduct an experiment in a mill under actual working conditions should be carefully considered before it was put into practice. One such experiment had been made by the Fine Cotton Spinners' Association, and had partially failed because it was not known at the time that the minder rattled the counterfaller in order to signal to the piecer at the other end of a long mule. Such matters might appear trivial, yet they meant sometimes all the difference between success and failure. The scientist was prone to study materials too much and his fellow-men too little. The strength of the textile industry in the future would depend upon the adaptability to changing conditions of the men who were maintaining it at its present level of efficiency, while the leaders who piloted them to success would be regarded deservedly as great men.

Mr. E. C. de Segundo wished, as an experimentalist, to take up the cudgels on behalf of the scientific man. Mr. Slater's criticism was severe, and correct to a certain extent, but there was also the point of view of the scientific man

himself to be considered. It was very seldom that the scientist was able to make his experiments under actual working conditions, and therefore it was unfair, when he had done the best he could with the means at his disposal, to state that his results were not borne out by experience in the mill. Personally, he was painfully aware of the unavoidable unreliability, from a practical point of view, of the results obtained by experimental work. A certain amount of compromise was always necessary, according to the governing factors of the situation. It was obviously not possible to adhere too closely to a determination arrived at in the laboratory, which might have been worked out to twelve places of decimals, under actual working conditions. He would like to ask whether, in connection with the process of cotton opening, the cotton hairs were actually damaged through being beaten by an iron bar.

Mr. F. P. Slater replied that by a special sub-microscopical method it was possible to detect the difference between a beaten and an unbeaten cotton hair.

Mr. de Segundo said that when observing the droppings from the scutching machine he noticed there was quite a large quantity of good cotton wasted and mixed with the trash and dirt. After investigation, he had come to the conclusion that once dirt was intermingled with cotton hairs in this way they were valueless, as it was almost impossible, by mechanical means, to segregate the contaminating material. Without desiring to criticise present-day methods, it might be a useful line of research to endeavour to modify the opening and scutching processes so as to avoid so much scutcher dropping.

Dr. Withers said that he had been careful to state that it was necessary to define what was meant by "damage." The Shirley Institute had obtained samples of cotton from a variety of opening processes in different mills. The tests showed that there was no appreciable alteration in staple length or in individual hair strength; whether there was any subtle damage which had not been detected was another question. Sweeping generalisations as to "damage" were not helpful.

Mr. Slater pointed out that after all cotton hairs did not remain merely cotton hairs, or even yarn. There was the problem of subsequent bad workmanship to reckon with. The whole of the processes of preparation and manufacture must stand or fall together.

Mr. de Segundo mentioned that 25 years ago he was a member of the Mechanical Engineers' Research Committee on Marine Engine Trials. Some broad-minded steamship owners very kindly permitted the Committee to carry out tests on certain steamers when on actual voyages. Thirty-six hour trials were carried out for the purpose of measuring the water consumption, and the results led to very useful innovations being made. If textile research workers could have a spinning mill placed at their disposal, they would speedily arrive at some good results from the practical man's point of view. The scientific man should be given a chance to apply his science to practice.

Mr. J. W. Baron did not think the mill was the proper place for the scientist, though he certainly ought to have access to it occasionally when necessary. What was required was to instil a spirit of research into the millworkers themselves, so that they could make their own observations and reports. A mass of information could thus be collected which would materially assist the scientist in the solution of the problems with which he was confronted.

Mr. Slater thought that if the scientific man went into the mill he was bound to be a nuisance to the operatives, who would regard him as interfering with their bread and butter. If the business man would compensate the operative for any loss of working time, then some good result might be obtained.

Mr. W. Bailey said that he had conducted a large number of experiments over a number of years, principally in connection with textile machinery. Results obtained under engineering works conditions were apt to become considerably

modified in actual mill practice. He was very interested in the remark of Dr. Withers as to proving whether the spindle or the traveller put in the twist with the ring-spinning frame. This had been a bone of contention not only with cotton spinning people but with students for many decades.

Mr. T. F. Robinson thought that theory was of little value without practical demonstration, and there should be co-operation between the scientist and the practical men of all branches of the textile industry. The suggestions made by Dr. Withers were of a distinctly practical character, and he felt that this paper marked a definite step towards breaking down the barrier between the scientists and the practical men. The Textile Institute through this lecture would make a valuable contribution to the task of bringing about the essential co-operation of theory and practice.

Mr. F. Nasmyth moved a vote of thanks to Dr. Withers for his interesting paper, which had certainly opened a new field for discussion. Personally, he had hoped for a little more elucidation of the type of personnel which would be necessary for the mill of the future. A change was impending, and yet they were all a little uncertain as to its precise trend. There should be certainly some liaison between the students of the Colleges of Technology and Research Departments such as the Shirley Institute. Immediate results should not be looked for from research associations, as for the demonstration of useful methods time and experience were necessary. Nevertheless, they were entitled to look to research associations for some sort of lead and guidance to the Colleges of Technology as to what direction the training of students should take. The practical man in the Lancashire mill was very conservative, and thought he knew a great deal more than the scientist. However, they must not think of the mills of to-day, but of the mills of the future. The Textile Institute was a means whereby a young technical student would be enabled to climb the ladder of success, and the recognition of his technical qualifications, which it could confer upon him by virtue of the provisions of its charter, would prove of inestimable value.

Mr. J. Crompton seconded the vote of thanks. He thought the relationship between industry and research was happily explained in the paper. The meeting had been a very profitable one, and he could not help coming to the conclusion that out of such gatherings something great and wonderful was bound to materialise.

Dr. Withers briefly responded to the vote of thanks, and the proceedings closed.

London Section

Discussion Meeting in the Institute's Rooms, 38 Bloomsbury Square W.C.1, 9th December 1925, Mr. A. R. Down in the chair.

THE SPECIFICATION OF TEXTILES FOR CONTRACT

After being introduced by the Chairman, the lecturer, Mr. H. B. Heylin, said his remarks would principally refer to textiles woven of cotton, linen, woollen, jute, and hemp, which were by no means obsolete despite the advent of a "silky cellulose product of uncertain nomenclature." By "specification" he meant the furnishing of all those particulars which defined the construction of a fabric. Advertisement and shop-window descriptions might be considered as specifications of a crude type when they implied in a general way the quality of the material or article for sale. It was not uncommon, unfortunately, for customers to be deceived by a shop assistant, either deliberately or unconsciously, into buying textile materials other than those they required; while a smart salesman may succeed in impressing a departmental buyer with such terms as "strong," "durable," "tenacious," "well-milled," "well-shrunk," "pure," "waterproofed," thereby effecting a sale without regard to the facts of the case. These, however, were minor aspects of the question of fabric specification which he would deal with in relation to the supply for the wholesale market, herein the product must be standardised in quality and purity. Though those who handle textiles constantly may be able to convey such a definite idea of their requirements that the "making particulars" can be planned out by the manufacturer himself yet under such circumstances it would be surprising if two manufacturers succeeded in producing fabrics exactly the same in all respects. On the contrary it is possible for a person possessed of accurate knowledge to convey a specification to any reliable manufacturer and in every case to receive his fabric with very little variation. In reputable textile circles where buyer and seller, merchant and manufacturer understand each other, large quantities of goods can be ordered against "a quality pattern" and the manufacturer will ascertain the "making particulars" by cloth analysis. Details of width, length, finish, make-up, &c., would be supplied on the order sheet, and tolerances would be allowed according to the customs of the trade or to recognised standards. Sometimes a merchant or middleman supplies full "making particulars" and the manufacturer has no need to resort to cloth analysis; while in exceptional cases all the warp and weft yarns required are supplied with the full specification by the merchant and then the manufacturer will probably weave the cloth on commission. Thus, said Mr. Heylin, where properly qualified buyers and sellers are concerned confidence is engendered and the satisfactory working of a contract is ensured. It is the exception rather than the rule for textile goods to be delivered not up to standard in regard to quality and general make. The large majority of spinners, doublers, manufacturers, dyers, and finishers have reputations to uphold and whose aim is to give the best of service to the textile trade.

The lecturer then proceeded to deal with the issue of specifications by authorities, organisations, Government departments, &c., who are buyers of large quantities of textile goods. How the lack of technical knowledge and of the conventionalities of the industry often resulted in the laying down of conditions more calculated to hinder than to help the manufacturers and to impair the efficiency of the goods was carefully explained and an outline of what might be considered a reasonable method of framing such specifications was given by the lecturer. In the event of controversy as to the quality or standard of a fabric it is essential that the matter should be referred to the decision of a person well qualified by training and experience to give judgment. To such persons, who may themselves be said to come up to a high standard specification, there should be awarded the hall mark of their profession. Their title to such distinction

can only be measured by their mental training and practical industrial knowledge. The degree of technological qualification to be demanded by the Textile Institute now that its Charter was an accomplished fact—must be of the highest, and Mr. Heylin intimated that all the world awaits with interest an announcement as to which members were adjudged worthy of the new distinction. As a foundation member, he hoped to see evidence of a high standard and of early progress.

Discussion

The Chairman said he found that practically the whole of the shipping buying was done on sets of samples sent out or on samples carried by travellers. He did not think they would find many buyers in London with the necessary technical education for drawing up detailed specifications for a manufacturer. That was what the Textile Institute in London were out to correct. They really wanted to reach 300 members at least by next year, and by then they would have funds enough to launch out and perhaps interest education authorities in London to give classes to educate young persons as to how cloths were made.

Mr. E. B. Fry said that it was of great importance that specifications should be given in a proper way, as when they were given in a haphazard manner all sorts of variations could creep in. He thought that specifications should be fairly complete, otherwise there would be a great deal of difficulty in interpreting them.

Mr. C. Coleing asked if Mr. Heylin thought that shippers and other big buyers of fabrics should possess qualified officials who would be able to supply the form of specification he had described, because speaking from his own knowledge of the retail and shipping business, both of which he had been interested in, he had never heard of anybody doing anything of the sort in a technical manner. He rather gathered that Mr. Heylin indicated that the specifications prepared by public bodies of this country were in need of overhauling. Was that so, and in what connection did he think the Textile Institute could take the matter up and deal with it ?

A member of the audience asked whether one ought to mention the condition of humidity required at the time of the strength test.

Mr. Heylin said that from one point of view a sample acted as a specification, and that was the way a tremendous amount of business was done. On the exchanges in the North, between man and man, a certain amount of confidence existed. He believed that many shipping offices had technical experts who examined cloth. He would be very bold indeed if he were to tell them how a specification should be made, because there were many ways according to the different view-points. What one might think was not essential, another might. It was a matter where the Textile Institute with its body of qualified men could sit round a table and do something perhaps in a few hours that some other bodies could not do in as many years. As to what should be included in a specification no one man could say that it must be such a percentage of this or of that without deviating one iota. There had to be a little elasticity. With regard to allowance for moisture, it was far better to ascertain what that should be and lay down reasonable rules so far as the moisture in yarn was concerned, but when they got to the woven fabrics they were up against many difficulties. The Textile Institute would be the best authority for making out specifications for guiding purposes.

Replying to a member present, Mr. Heylin said he was not against a strength test but it should not be made a primary feature.

Mr. Fry asked if putting the strength test in a subordinate position did not open the way for the manufacturer to use slightly inferior material. If a man wanted to reject he could find some other ground than a strength test.

A visitor thought that Mr. Heylin had brought out an important point which emphasised the necessity for the Institute taking up the question of specifications.

Mr. J. Howard said he was entirely at variance with Mr. Heylin on the strength test. He defied him or anybody else to settle quality without a strength test. It was such a remarkable factor in quality that no manufacturer dared use yarn

until he tested it. No one could tell the quality of yarn or length of fibre without putting it on a testing machine. The question of humidity must be left to experts alone. The testing machine used by men who were always at it was a much more accurate thing than people believed. The last thing he would take out of a specification was the breaking strain.

Mr. Heylin said he did not definitely say that the strength test was no use; it was very useful but he did not look upon it as the primary factor. He did not think it would be wise for any manufacturer to be without the single thread testing machine, but when threads were put into cloth there were further conditions to be considered. Manufacturers would aim to satisfy the strength test, if that was made a paramount feature in the specification.

Mr. Howard said if the actual strength required was not put in the specification, the manufacturer could make the cloth to specification without making it to quality. Given a satisfactory weight it was the best cloth that pulled to the best strength.

The Chairman asked the Secretary of the London Section to answer a visitor who asked whether the Textile Institute would not consider promoting the formation of a Testing House in London.

Mr. Featherstone stated that this question had been very seriously considered by the London Section Committee; that a proposal to form such a Testing House had met with the warm approval of many trading organisations, but that no promise of any financial support whatever could be obtained. The Committee therefore had been compelled to let the matter drop.

Mr. Heylin thought the discussion showed that there was plenty of room for the Textile Institute.

Mr. Coleing moved a hearty vote of thanks to the lecturer, which was seconded by Mr. E. B. Fry, and carried unanimously.

NOTES AND NOTICES

Annual Election of Vice-Presidents and Council

The arrangements with regard to the annual election of Vice-Presidents and Council of the Institute are considerably changed for the years 1926 and 1927, as a result of the reconstitution of the organisation under the Royal Charter and new Bye-laws. Ordinarily, at least three Vice-Presidents and ten Councillors are due to retire and are eligible for re-election unless disqualified by non-attendance or other reason mentioned in the Bye-laws. The three Vice-Presidents and ten Councillors to retire in the usual course of events would be those who had been longest in office, but for 1926 and 1927 the Council have to decide the retirements. At the Council Meeting on Wednesday, 20th January, the decision arrived at by Council creates three Vice-Presidential vacancies and ten Council vacancies. Nominations are now to be invited and it has been decided to issue a special nomination form direct to members. This year there will be ten absolute vacancies for the Council owing to several cases of ineligibility and retirements for other reasons. On receipt of nomination form, members are invited therefore to bestir themselves in this highly important matter of nomination for election at next Annual General Meeting, which is due to take place at the Institute at Manchester on Wednesday, 21st April. The time for return of nominations is stated on the form, and it is important to note that additional nomination forms may be secured on request to the General Secretary.

The Institute Diplomas

Notwithstanding the fact that no announcements are yet available in regard to the award of the new Diplomas of the Institute (Fellowships and Associateships), the statement may be now made that the publication of the first list of

successful applicants may be expected to be published in an early issue of this *Journal*. The fact is that applications have come to hand in such considerable number that the Selection Committee, in spite of unusually prolonged meetings and deliberations, is not able to keep pace with the immediate demand. Applications for the most part require extended consideration, and it is the rule that before definite recommendations are made to Council, the Committee's own decisions are subject to confirmation at a subsequent meeting. The General Secretary of the Institute has received many inquiries from applicants as to progress in regard to applications. All applicants should note that no real delay is permitted, but that the formidable task which confronts the Committee involves a period of time which cannot be reduced owing to the sheer force of the circumstance of numbers of applications to be dealt with. Certificates have now passed the stage of printer's proof, and announcement of the decisions of the Committee and confirmation by Council is being expedited to the utmost extent.

Exhibition of Knitted Fabrics and Yarns

In connection with the Lancashire Section of the Institute, it is proposed to hold an Exhibition of Knitted Fabrics, and Novelty Yarns for Hosiery or Knitted Fabrics, on the 18th, 19th, and 20th March, at the Institute Headquarters at Manchester. The Council has given special sanction to the Lancashire Section Committee to embrace the whole field of membership of the Institute in respect of the organisation of the fixture and invitations to exhibit. Exhibitors will be limited, except in the possible case of technical institutions, to firms directly or indirectly represented in membership of the Institute. Any member who can assist either by suggestion to the organisers or by securing an exhibit should communicate with the General Secretary at the earliest possible date. It is felt that a stage has now been reached in regard to knitted fabrics and yarns when a really representative collection should be got together. It is proposed a discussion meeting on either the first or second day of the exhibition, and the British Association of Textile Mill Managers will be specially invited to take part in the meeting. The organisation named invited the Lancashire Section members of the Institute to their meeting on Saturday, 23rd January, when a lecture on "Yarns for the Hosiery Trade" was contributed by Messrs. J. Chamberlain and J. T. Stokes, of Leicester. Apart from the circular letter which is being issued to members generally, the General Secretary would be grateful for immediate proposals to exhibit on the part of any firm connected with membership of the Institute.

Annual Balance Sheet and Accounts

A draft of the Balance Sheet and Accounts for 1925 was presented to Council at its meeting on 20th January, and were approved subject to certain adjustments in the way of special assignment of revenue from the Foundation Fund investments. By comparison with the record for the previous year, the accounts for 1925 show a decided improvement in the financial position of the Institute. In place of the small deficit brought forward from 1924, there is a small excess of income over expenditure for 1925. It will be recalled, of course, that the small deficit brought forward at the end of 1924 did not represent the entire deficit for the year, because previous surplus had also been absorbed. The membership subscription revenue shows a considerable improvement, whilst not only has economy been secured in regard to the *Journal*, but substantial improvement of revenue has materially helped the general financial situation. The restoration of the condition of the finances which prevailed at the end of 1923 is not yet effected, but the outlook is encouraging and it is confidently hoped that the previously existing surplus will eventually be re-established. The fact should be stated that whilst additions to membership have latterly

accrued at an unprecedented rate, nevertheless there have been quite a considerable number of withdrawals. Notwithstanding that the former outpace the latter, yet the Council is most anxious that no effort should be spared in promoting increase of membership, and all existing members are invited to assist in this direction during the current year.

Competition in Novelty and Folded Yarns

The Institute's Committee in charge of the Crompton Prize Fund Scheme, under which prizes are offered annually in regard to design and structure of woven fabrics, has this year embarked upon an additional enterprise. On the suggestion of the Committee, the Council of the Institute agreed that donations should be invited in order that prizes may be offered for special yarns. Messrs. R. Greg & Co. Ltd. (South Reddish, Stockport), have kindly consented to contribute £25 per annum for three years. The Crompton Scheme Committee has accordingly prepared a competition for the current year, the object of which is to encourage effort on the part of students in the Spinning Departments of Technical Colleges and Schools. Prizes of £8 and £4 will be offered in each of two classes—for Novelty Folded Yarns, and Folded Yarns respectively. Details and conditions are attached to the general prospectus, the issue of which is expected to take place before the end of January.

Membership Certificate

An interesting case of recovery of personal effects inadvertently left in a compartment of a continental railway train has recently come to our notice. A member of this Institute recently left a pocket wallet in a train between Paris and a Cross-channel seaport. Fortunately for the owner, the wallet contained a certificate of membership of the Institute. The result was that a communication was received at the Institute intimating that the wallet had been found. The member in question was notified and, in the course of a few days, we received a grateful letter from the member stating that the wallet had been returned to him, with the contents complete.

Section Activities

In addition to the Exhibition of Knitted Fabrics and Hosiery Yarns, of which notice is given above, the Lancashire Section Committee has arranged a meeting at the Institute, Manchester, on 12th February, at 4 p.m. Thereat two papers will be read and it is hoped discussion of a most valuable kind will afterwards take place. The papers in question are—

"The Effect of Sizes on the Elastic Behaviour of Flax Yarns," by Mr. J. A. Matthew (Belfast).

"The Detection and Estimation of Glycerol in Cotton Cloths and Sized Yarns," by Mr. George Smith (Great Harwood).

In the case of the second paper, the author is unfortunately unable to be present to read his contribution, and arrangements have been made for a member of the staff of the British Cotton Industry Research Association to do so in his stead. These papers will subsequently appear in the *Journal*, together with a report of the discussion. The Yorkshire Section Committee will have before it at an early date the proposal to arrange for a similar meeting, and three papers, one by Mr. W. Rhys-Davies and the other two by members of the staff of the British Research Association for the Woollen and Worsted Industries, have been submitted as especially suitable for presentation to the members of the Section. This marks the onset of a definite policy in respect to the reading of papers, and it is hoped that in all cases adequate support will be given to the efforts of the Section Committees.

COMMUNICATION

To the Editor

Sir,—We have recently had experience of grey mixture pieces, the black component of which was dyed with Azo Chrome Blacks of the Eriochrome Black type, turning up after finishing with a slight yellow cast on the white wool. This yellow cast spoils the clear blue tone of the finished goods, and we considered it advisable in the interests of trade generally, that the cause of this fault should be discovered, and remedies applied.

As a result of a considerable amount of work done in this laboratory, and also on a practical scale, we are now able to state that the fault is due to free sodium carbonate being left in the goods after scouring and milling, and only occurs when such is the case. We have further proved that the fault is increased where a very greasy wool has been dyed, and the grease has not been entirely removed in the dyeing process. Grease, however, is not the cause of the fault, but merely an assisting factor.

The fault can be remedied—

(1) By thorough washing off after milling.

(2) By adding a little of any acid to the washing-off liquor.

Acetic acid, however, is not advisable since its sodium salt gives an alkaline reaction, and we recommend formic acid as the most suitable on account of its strength, and the fact that any slight excess volatilises on drying.

In cases where the handle of the goods may be impaired by this final treatment, the excess of acid should be again neutralised with a little ammonia. This, however, will not be necessary except under the most extraordinary conditions.

We should be obliged if you would publish this communication, as we consider these facts should be widely known, particularly among finishers.

(Signed) *For* C. Roberts & Co. Ltd., Bradford
F. Goodall, M.Sc., *Chemist.*

REVIEWS

Die Schwefelfarbstoffe ihre Herstellung und Verwendung. By Dr. Otto Lange. Otto Spamer, Leipzig (Zweite auflage, 1925, 25 Gm.)

"If an inquiry thus carefully conducted should fail at the last of discovering the truth, it may answer an end as useful, in discovering to us the weakness of our understanding. If it does not make us knowing, it may make us modest. If it does not preserve us from error, it may at least from the spirit of error, and may make us cautious of pronouncing with positiveness and with haste when so much labour may end in so much uncertainty."—*Edmund Burke.*

Fourteen years have passed since the appearance of the first edition of this book. During this time there has been little or no advance in our knowledge of sulphur colours. No new colours of note have been prepared and no advance has been made through the mysterious hinterland of darkness with which their constitution is still, for the most part, enshrouded. The only definite crystalline sulphur colour derivative is still the bisulphite compound of Immedial Reinblau, and the only well-substantiated grouping is the thiazine ring; but how it is figured in the molecule we are still in ignorance. Dr. Lange himself regretfully labels the period sterile. This absence of advance (even taking the effects of the war into consideration) forms a most remarkable period in scientific and industrial chemistry. When we consider the enormous stride taken from the primitive sulphur colours of 1895 to the bright shades from esoteric combinations of 1910, the contrast is strangely marked. It was during this fifteen years that the majority of the sulphur colour patents were granted and countless workers in the laboratories of the German colour firms feverishly mined the new ore. Then quite suddenly a great silence . . . . as though the rich seam had suddenly petered out. Shall we see great discoveries in the future of this branch of knowledge ? It is hard to prophesy. It may be that we shall yet see chlorine fast sulphur blacks which will be cheap enough to supplant developed aniline blacks. Perhaps . . . .

In general terms this book is a reprint of the first edition with some omissions. We think it has suffered by this cutting. Some chapters (e.g., Anorganische Ausgangsmaterialien:Schewefelung organischer Körper) of the first edition have been removed bodily, and one at least (Organische Ausgangsmaterialien) has been cut to a quarter of its size—although we are consoled by the author who directs us to find the remainder in another of his text books (*Die Zwischenprodukte der Teerfarbenfabrikation*, Leipzig, 1921). The present edition is still divided into two main parts dealing respectively with sulphur colours *per se* and with their application. The first part contains (among many others) a precise account of work done on theories of structure, which is a miracle of compression. Those chapters dealing with the very great variety of starting materials and intermediate compounds are complete and thorough, with the exception noted above. At the end of the volume will be found extracts from some 747 patents which comprise the majority of the literature of the subject. The second part of the book is concerned with the application of sulphur colours for dyeing as well as for textile printing. A comprehensive account is given of colour testing, dyeing, and development in every one of their numerous phases, as well as diagrams of the most widely used dyeing machines. The chapter dealing with cotton printing of sulphur colours develops the subject logically and includes diagrams of machines and clear descriptions of a variety of processes.

The first edition suffered from a lack of satisfactory indexes—almost a unique lacuna in a German scientific work. We regret very much that the second edition errs still further in the same direction. The admirable cross reference system for patent numbers (based on that initiated in Friedländer's Teerfarbenfabrikation) has been suppressed entirely. This omission detracts seriously from the use of this edition as a work of reference. Further, there is a crying need for a special index for trade names of colours and we strongly urge the publishers to consider this when preparing a third edition. These trade names form the most practical means of referring to a given colour and they occur in the most unexpected places. A search for a desired name in the present edition is likely to be a most laborious affair. The addition of such an index together with a complete subject index would add much to the value of the book. This edition in its precise completeness will be found a very valuable equipment for those engaged in the industry. The colour manufacturer as well as the dyer will find all the information he needs here, and the work should make in addition a special appeal to those imaginative investigators whose thirst for problems worthy of their steel leads them into strange places. R.W.P.

Trade Stability and how to obtain it. Sir Charles Macara. Sherratt and Hughes, Manchester.

This book is a collection of the writings of Sir Charles Macara upon the question of Cotton Control. There is very little in it that appears for the first time; and the purpose of the volume would appear to be the bringing together and classification under chapter headings of a number of newspaper articles, letters, and opinions bearing upon the problems with which the Provisional Emergency Cotton Committee is concerned. The character of its matter necessarily introduces into the book a certain lack of cohesion; but any person desiring to acquaint himself with the case for Control will find here all he requires.

Perhaps the details of the case are not so well known as they ought to be. Controversy has necessarily introduced irrelevancies and personal expressions of opinion which tend somewhat to cloud the issue. Sir Charles' thesis, in brief, is as follows. Over a period of thirty years the spinning section of the cotton trade, or more precisely the American section, has not paid, on the average, more than 5 per cent. to its shareholders; and the value even of this return must be discounted for its variable and uncertain character from year to year. This small return is due (*a*) to lack of co-ordination among spinners, and (*b*) to their large measure of dependence upon one source of raw material supplies. The expedient of organised short-time which the Federation of Master Cotton Spinners has from time to time adopted, is not rigidly observed by a certain number of mills; and in any case is not able to function adequately, since there is neither a statistical measure of the exact extent of the need for it, nor do the rules of the Federation allow of its being recommended to members except on the basis of an 80 per cent. vote in its favour, which will be given only in cases of extreme

and general depression. The proposed Control Board is relied upon to secure the requisite data as to production, consumption, and stocks of yarn; and sanctions for the observance of the recommendations of the controlling authority are to be devised in conjunction with the operatives' unions, which undoubtedly have as close an interest in the well-being of the trade as the shareholders of the capital invested in it. The sanction proposed is the withdrawal of labour from the mills of recalcitrant firms.

Such is the argument. The outstanding proposals are those regarding the collection of statistical data and the introduction of sanctions. The first is one that must soon pass beyond its present stage. The general tendency in modern industry is for more light on these matters which have hitherto been regarded as strictly the concern of individuals. This change of attitude is particularly noticeable in the United States, where it has been realised that knowledge, even of the worst, is better than struggling in the dark; that with it readjustment of production to demand, over a period, is much more exact and much more prompt. It is better that everyone should know the worst, and how bad it is; they can then decide what to do about it. Sir Charles goes no farther than to propose that the controlling authority should have possession of this data. The Americans publish it for everyone to see. As to the second proposal, it is simply an elaboration of the short-time policy of the Federation on a more effective basis. With the latter it shares certain advantages and disadvantages; it might, for instance, be used to bolster up the inflated capitals of certain mills. But there is a defect, inherent in all authority, that the Control would introduce. This is the risk of injustice being done in individual cases; orders would necessarily have to be general and to ignore all except wide classifications of firms. "American Section" is a term embracing firms working for a wide variety of markets; and presumably that amount of individual discretion allowed—by conscience—under the present short-time scheme would be removed. From the point of view of the trade in general, there is another objection. The aim of "control" is what the name implies, control of supply, restriction of output; it is the short for "monopolistic control." It is the substitution of common policy, backed by authority, for spontaneity in business relationships; and before any such step is taken the consequences of it must be scrutinised most carefully. Nevertheless, the proposal is a serious one and deserves serious consideration, for which this book affords opportunity.

G.H.M.

GENERAL ITEMS AND REPORTS

Advisory Council—Department of Scientific and Industrial Research

The Secretary of the Department makes the following announcement—"Dr. George Christopher Clayton, C.B.E., M.P., and Professor Henry Cort Harold Carpenter, F.R.S., have been appointed by Order of Council, dated 16th September 1925, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research." Professor Carpenter occupies the Chair of Metallurgy in the Royal School of Mines, South Kensington, and is well known for his researches on metals and alloys. Dr. Clayton, who represents Widnes in the House of Commons, is a Ph.D. of Heidleberg, and a Director of the United Alkali Company.

Some Diseases of Cotton as seen in the Plantations

Before the Manchester Literary and Philosophical Society on 8th December 1925, Dr. W. Robinson read a paper upon the above subject, Dr. H. Levinstein, President of the Society, being in the chair. Dr. Robinson said* that in order to facilitate research work being carried out in the University of Manchester, for the Empire Cotton Growing Corporation, a visit was paid to some of the Cotton States of America in the summer of 1924.

The diseases of cotton described were observed in the plantations of North and South Carolina. In that season, according to recently published estimates by the U.S. Department of Agriculture, fungal and bacterial diseases of cotton reduced the crop in the U.S.A. by one million, nine hundred thousand bales.

*Report furnished by the Secretary, Manchester Literary and Philosophical Society.

The extent of these losses in what was a relatively favourable season for cotton growing indicates the importance of these diseases.

In the United States some of the diseases are more important than others, but, at the present time, all of them may be important to this country in view of the considerable extension of cotton-growing in progress in various parts of the British Empire. In some of these countries a new crop plant is being introduced; we have little knowledge how it will react to its new environment and we do not know what diseases will appear. It is certain, however, that some diseases will occur, and it is well known that a disease which is relatively harmless in one country may become destructive in another.

This may be illustrated by some of the diseases seen in the United States. *Bacterium malvacearum* causes the angular leaf spot and a boll disease on Upland varieties of cotton (*Gossypium hirsutum*), the leaves and bolls usually being the only parts of the plant affected. The Sea Island and Egyptian varieties of cotton (*G. barbadense* and *G. peruvianum*) are much more susceptible to the attacks of the organism which also affects the leaf stalks and branches, causing the "Black arm" form of disease. This "Black arm" disease is already causing serious concern in the Sudan on Egyptian cotton, although in Egypt, presumably on account of the different climatic conditions, it is not troublesome. It is now known that infection may be carried on the seed, and seed-disinfection has proved successful in preventing the disease in the United States.

Again in the U.S.A. several root-diseases of cotton occur. Of these the Texas root rot (Ozonium) and the wilt disease caused by *Fusarium vasinfectum* are of most importance. In the latter case the disease was studied in South Carolina on badly infected soils. The fungus present in the soil passes into the conducting tissues of the plant and excreting poisonous substances leads to dwarfing, wilting, and killing of the whole plant. In the Sudan a root-disease (the Tokar root-rot), undoubtedly different from the Fusarium wilt or Texas root-rot but capable of stunting and killing the plant by progressive infection, is also causing trouble. Work at present in progress on this disease should ultimately determine its cause and probably provide for its control.

Diseases of the immature or opened bolls are commonly caused in the U.S.A. by *Glomerella gossypii* (anthracnose disease), *Fusarium, Diplodia*, and by *Bacterium malvacearum*. The cotton lint is destroyed, weakened, or discoloured by such organisms. Similar boll diseases occur wherever cotton is grown, and recent studies by Mr. R. W. Marsh on discoloured cotton from Nyasaland have shown that the yellow discoloration is due to a species of *Nemataspora*, a fungus which in the West Indies has been shown by Nowell to be inoculated into the bolls by cotton stainer bugs which puncture the bolls as they feed. Stainer bugs were observed feeding on cotton bolls in South Carolina, but the *Nemataspora* fungus is not up to the present known to cause disease of cotton in the U.S.A. Other diseases of cotton studied were those caused by species of *Alternaria* and *Ascochyta gossypii*. These have not hitherto been of serious consequence in the United States, but the latter is now spreading, and both diseases may prove much more harmful in other countries.

Of the diseases to which reference has been made several have as yet been imperfectly studied, and only by extended work on such diseases and on the organisms responsible for them will it be possible for the growers and plant pathologists in cotton countries to guard against outbreaks of disease and to devise satisfactory means of control when such outbreaks occur.

Woollen Spinning

Mr. W. O. R. Holton, lecturing on "Woollen Spinning" before the Bradford Textile Society on Monday, 7th December, 1925, said that the making of a good woollen cloth required a good woollen yarn, and the problem of the woollen manufacturer was to make a blend which would spin well and produce a satisfactory thread at the required cost. Raw materials must be carefully selected for blending with a view to producing the "finish" effect required by customers and to producing a sound well-blended woollen yarn. The lower the cloth, the more essential this was. The manufacturer must master all the different combinations which could be made by the use of long coarse wools, cross-bred, fine cross-breds, merinos, wastes from the worsted section, mungoes, and shoddies of all descriptions. Machinery must be well built on proper lines in order to turn

out work of good quality in sufficient quantities to enable the manufacturer to compete; and the lower the quality of material used, the more efficient and up-to-date the machinery must be. A good spinning blend could be completely spoilt by bad blending or uneven oiling. The carding process was recognised as the chief factor in the successful spinning of woollen yarns. The engine was somewhat similar to that used in the Bradford trade, but the card clothing had to be of quite a different kind in order to card and open out the very short materials used, whilst it must be more flexible and pliant. The self-acting woollen mule was easily the most complicated and wonderfully constructed machine employed in woollen cloth manufacture. The scroll was described as the soul or principle of woollen spinning. In the woollen process the human element was more largely called upon than in cotton or worsted spinning, and the faculties of observation, intuition, and quick decision were essential. One set of rollers only was used, and the purpose of it was simply to feed and hold fast the condenser threads or slubbing. When the rollers stopped, the mule carriage and spindles were about half-way out, and as the mule continued to get further away, the spindles imparted the requisite amount of twine and draft, and thus produced a frizzier yarn than the roller drawing process. The working of the scroll and twine called for very precise judgment even on the part of the most capable spinners. The art of spinning consisted of first obtaining the ideal thickness of condenser thread, which was not a fixed quantity proportional to the thickness of the yarn required, but varied with the qualities of the material of which the blend was composed and the type of yarn required. Then followed the regulation of (1) The speed at which the condenser threads passed through the rollers, and therefore the precise time at which these rollers were stopped; (2) the speed and regulation of the mule coming out; and (3) the speed at which the spindles were run. If the thread were drawn too tightly in the early part of the draw, the resultant thread would be uneven and tight. It was highly necessary that strict attention be given to the human element. When everything had been done in the way of good blending and an efficient foreman had exerted all his skill, the keeping of the yarn up to quality depended a great deal upon piecers in the mule gate. M.

Exhibition of British Artificial Silk Goods

The Drapers' Organiser is arranging the first exhibition of its kind to be held at Holland Park Hall, London W11, from 19th to 24th April. Exhibits will consist of the products of manufacturers, dyers, and finishers of yarns and fabrics made either wholly or in part of artificial silk. The artificial silk industry will be revealed from the yarn production to the finished and dyed fabrics, and thus will be indicated in the fullest possible way all sources of supply. In addition, daily mannequin parades will be held to display gowns in artificial silk or artificial silk unions designed by the leading costumiers. The trade alone will be admitted during Monday, 19th April to Friday, 23rd April, but on Saturday, 24th April, the general public is to be admitted. There is evidence that this exhibition will be a most successful venture.

Competition of Industrial Designs

The Royal Society of Arts announce their annual competition in various classes of industrial designs to be held in June next. Particulars as to classes of candidates and methods of entry, preparation of designs, &c., are ready and may be obtained from the Secretary, John Street, Adelphi, London, W.C.2. Of particular interest are the competitions in Textiles, in which the subjects of competitions are designs for the following—

Sub-section (1) Floor Coverings, including Carpets and Rugs, Linoleum, and Floor Cloths.

,, (2) Woven Fabrics for Furniture and Decoration, including Tapestries, Damasks, Brocades, Figured Velvets, Table Damasks, and Moquettes.

,, (3) Printed Fabrics for Furniture and Decoration.

,, (4) Printed and Woven Fabrics for Dress, including Brocades, Fancy Dress Fabrics, Handkerchiefs, Tie Silks, Mufflers, Ribbons, and other narrow goods.

Sub-section (5) Machine-made Lace, Lace Curtains, and Embroidery.
,, (6) Miscellaneous, including Hand-made Lace, Embroidery, and Open Work, Bedspreads, Cushion Squares, Tea Cosies, Batiks, &c.

Candidates may submit designs for any or all of the items in any or all of the foregoing sub-sections. The prizes offered are sufficiently attractive and consist of one or more Travelling Scholarships to candidates of outstanding ability. In 1925 one such Scholarship of £150 was awarded. In addition the Judges are empowered to award money prizes up to £10 10s. each for designs in any of the sub-sections mentioned above.

Dyestuffs (Import Regulation) Act 1920

The following statement relating to applications for licenses under the Dyestuffs (Import Regulation) Act 1920, made during November and December, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee.

The total number of applications received during the month of November was 682, of which 579 were from merchants or importers. To these should be added 34 cases outstanding on the 31st October, making a total for the month of 716. These were dealt with as follows—

Granted, 597; referred to British makers of similar products, 76; referred to Reparation supplies available, 5; outstanding on 30th November 1925, 38. Of the total of 716 applications received, 608, or 85%, were dealt with within seven days of receipt.

The total number of applications received during the month of December was 571, of which 487 were from merchants or importers. To these should be added 38 cases outstanding on the 30th November, making a total for the month of 609. These were dealt with as follows—

Granted, 485; referred to British makers of similar products, 86; referred to Reparation supplies available, 14; outstanding on 31st December, 1925, 24. Of the total of 609 applications received, 534, or 88%, were dealt with within seven days of receipt.

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PROCEEDINGS

CHARTER OF THE TEXTILE INSTITUTE CELEBRATION PROCEEDINGS AT BRADFORD

In celebration of the grant of a Royal Charter of Incorporation to the Institute, a luncheon was held at the Midland Hotel, Bradford, on Monday, 25th January, 1926, at which Lord Emmott was the principal guest. The President of the Institute (Mr. John Emsley) occupied the chair, and amongst those present were—The Lord Mayor of Bradford (Ald. J. Stringer), the Mayor of Keighley (Ald. Arthur Smith), the Mayor of Morley (Councillor E. Kirby), the Mayor of Pudsey (Mr. Edward J. Byrd), the Mayor of Wakefield (Mr. Chas. Mellor), the Mayor of Brighouse (Ald. A. M. Denham), the Mayor of Pontefract (Councillor J. Hutchinson), and the Mayor of Todmorden (Mr. Wilson Greenwood); Lieut.-Col. A. Gadie, M.P. (Central Bradford), Mr. Eugene Ramsden, M.P. (North Bradford), Ald. T. D. Fenby, M.P. (East Bradford), Mr. T. W. Stamford, M.P. (N.W. Leeds), Mr. Ben Riley, M.P. (Dewsbury), Mr. W. Forrest, M.P. (Batley and Morley), Mr. J. Potts, M.P. (Barnsley); Mr. J. R. Pollit and Mr. Douglas Hamilton (Vice-presidents, Bradford Chamber of Commerce); Mr. F. L. Moorhouse (President, Huddersfield Chamber of Commerce); Mr. J. J. Stubley (President, Batley Chamber of Commerce); Mr. Howard Clay (Halifax Chamber of Commerce); Mr. Thos. R. Taylor (Cleckheaton and Heckmondwike Chamber of Commerce); and Mr. W. Muir Oddie (Ossett Chamber of Commerce); Mr. H. Sutcliffe Smith (Chairman, Colour Users' Association); Mr. B. Parkinson (President, British Wool Federation); Mr. Walter Andrews (Vice-president, Federation of British Industries); Sir Donald Horsfall, Sir William Bulmer, Mr. F. A. Aykroyd, Mr. C. W. Bridgland, Mr. J. W. Buckle, Mr. Harry Dawson, Mr. J. W. Downs, Mr. A. Hitt, Mr. James D. Law, Mr. A. F. Mombert, Mr. George E. Priestman, Ald. Thos. Sowden, Mr. Fredk. W. Turner, and Mr. W. H. Watson; Sir James P. Hinchliffe and Sir Percy Jackson (West Riding County Council), Ald. J. A. Guy (Chairman, Education Committee, Bradford), Mr. Thos. Boyce (Director of Education, Bradford). Mr. Fredk. A. T. Mossmann (Bradford Incorporated Law Society). Mr. F. W. Brearley (Bankers' Institute); Mr. C. A. Laurence (Midland Bank, Bradford); Mr. H. E. Wood (Barclays Bank, Bradford). Mr. Ernest Hickson (President, Society of Dyers and Colourists); Mr. Sydney E. Illingworth (President, Bradford Textile Society); Mr. A. Ollerenshaw (President, Halifax Textile Society); Mr. Wm. Scott (President, Shipley Textile Society). Representatives of the Textile Institute present included—Col. F. R. McConnell (Past President), Mr. Geo. Garnett (Vice-president), Mr. John Crompton (Chairman of Council), Ald. W. Frost (Hon. Secretary), Mr. T. Fletcher Robinson (Hon. Treasurer), Mr. Frank Nasmith (member of Council), Mr. J. D. Athey (General Secretary), Mr. H. L. Robinson (Editor *Journal*), and Mr. F. R. Thurlow (Assistant Secretary, Yorkshire Section).

Lord Emmott, in proposing the toast of "The Textile Institute," coupled with the name of Mr. John Emsley, congratulated the Institute on having obtained its Charter. The Institute would now, he said, be able to grant diplomas to those who practised textile technology, and would be on a par with such organisations as the Institute of Chemistry, the Institute of Mechanical Engineers, the Institute of Civil Engineers, and other similar bodies. In close co-operation with the Universities, a body of certificated technologists would soon arise who would not only provide an adequate supply of teachers but would become leaders of, and advisers to the textile trades. Scientific knowledge and experience were becoming increasingly necessary in the development of industries, and in this country, if he might venture a criticism, there had been too much rule-of-thumb. Too many of the practical Yorkshire and Lancashire manufacturers had almost a contempt for science, simply because they possessed those inherent qualities that made for success even in the absence of science. He was disturbed by the manner in which this country seemed to lag behind in new industries; and he hoped that the efforts of the Institute would at any rate keep us to the forefront in the great textile trades, in which we had been pre-eminent for so long a time. To Mr. Emsley he wished to offer his congratulations on the energy and generosity with which he had worked for the granting of a Royal Charter. Without Mr. Emsley, he doubted whether the Charter would have been in existence to-day; and he also wished to congratulate the Secretary and all others connected with the Institute who had helped in the movement. With regard to the general conditions of industry, he thought there was a rather better outlook. The decrease in unemployment, although there might be special reason that accounted for part of it, had been very marked and gratifying in the last two or three months. There was not so much heard about foreign contracts going to other countries. The stabilisation of exchanges in certain foreign countries, so far as it had gone, had helped rather than hindered us in the great competition that had to be met. Even in the wool trade and the cotton trade, the much lower prices that now existed should stimulate demand very considerably in the future. At the same time, we were more dependent on export trade than any other great country, and our great export trades were depressed on the whole. Until real improvement took place in these trades, there could not be anything like real prosperity in this country. The world was poorer. They were told by Sir Arthur Balfour's Committee that we were still retaining our proportion of the world's decreased export trade, but when he examined in detail some of the trades of this country he did not like what he saw. In the wool trade he did not think there was any reason to be unduly alarmed. If they had been depressed during the past year they could afford it, and it did not seem to be in any way a permanent depression. In the cotton trade there had been four or five years of acute continuous depression in the American branch of the trade, whilst France, Belgium, Holland, and Italy were working full time and making good profits. That was not a satisfactory state of things. Japan, too, was making serious inroads on the markets which we used almost to command. The basic fact was that cotton goods were too dear. The peoples of the tropical countries, receiving only 50 per cent. more for their commodities than they did before the war, could not buy so much cotton cloth as they used to do because it cost $2\frac{1}{4}$ times as much as before the war. In order to ensure full employment we needed to export about 6,000 million sq. yds. of cotton cloth, as against the 4,400 million sq. yds. of last year. He agreed thoroughly with the suggestion of Sir Christopher Needham that a committee should be appointed to investigate the whole position. It should be a committee which could tackle the problem with a perfectly open mind. He would suggest that it should include a prominent financier, a competent statistician, probably from outside the trade; a well-informed merchant; a thoroughly good spinner and a manufacturer; and a satisfactory representative of the operatives. No reasonable employer wanted to reduce wages; but if there was

no way of meeting the question without tackling wages, any reduction that might be made should be with the object of getting back to full time; and if there were any improvement in conditions, there should be effectual guarantees that a large part of that improvement should go to the workers and not to capital.

Mr. John Emsley, in replying to the toast, said that for too long in this country trade had been regarded as secondary to the professions. The textile trade, through the granting of the Charter, had now an allied profession, that of textile technologist, to which he hoped the best brains in the country would be attracted. There were endless possibilities before the textile industry, and all the sciences must be utilised for its needs. Perhaps in this country we had been a little too lax and self-complacent in industry, but we were wakening up and tackling our difficulties from the bottom, and he believed a period of greater prosperity was in store.

Mr. John Crompton (Chairman of the Council) then presented to Mr. Emsley the first Fellowship of the Institute. He said they must recognise the good work done by those who had preceded the Institute in this matter. The City Guilds of London were the pioneers of technical education; and there had followed the textile departments at the various Universities, where diplomas were granted which in themselves were quite sufficient to justify the Institute in awarding fellowships. But the Institute Charter stipulated that those to whom fellowships and associateships were granted should have specific periods of practical experience in the industry, so that they should not only be qualified from an academic point of view, but from the point of view of actual experience of the industry.

Mr. Crompton then read the address embodied in an album which contained the first Certificate of Fellowship of the Institute to which Mr. Emsley had been admitted. This address was as follows—

To JOHN EMSLEY Esq., J.P., Bradford,

President of the Textile Institute (Incorporated by Royal Charter 1925).

Desiring to place on permanent record their deep sense of appreciation of your services to The Textile Institute during the period of your Presidency (1922-3 to 1925-6), the Council of the Institute hereby present to you, on behalf of the Officers and Members generally, this Address of Congratulation upon the successful issue of your efforts to secure a Royal Charter of Incorporation for the institution.

Since the inauguration of the original Institute, incorporated under the Companies (Consolidation) Act in 1910, several proposals have been considered with a view to the creation of Diplomas on a basis of recognised qualification in Textile Technology in connection with Institute Membership. For various reasons, however, postponement was necessary.

After election as President in 1922, your immediate recognition of the importance of conferring Diplomas upon qualified members prompted you to assist a movement with this object in view. By your assistance and generosity, hereby gratefully acknowledged, all obstacles were removed, and the Institute was enabled to proceed with the presentation of a Petition to His Majesty's Privy Council in favour of the grant of a Royal Charter of Incorporation.

The preparation of the Petition, the framing of the Charter and Bye-laws, and the negotiations generally, occupied a considerable period of time, and your determination to witness the completion of the task you undertook in 1922, demanded repeated extension of your presidential services which you willingly undertook.

In the fourth consecutive year of your Presidency the grant of the Royal Charter was received.

Proceedings in celebration of the grant of the Charter have taken place at Manchester (14th October 1925), London (23rd October 1925), and Bradford (25th January 1926). It is in connection with the last-mentioned fixture that the

Officers and Council of the Institute ask your acceptance of this Address of Congratulation upon the success of the movement to obtain the Charter. This request is made in the firm belief and conviction that your efforts and generosity will prove of enduring benefit to the Institution and to the Industry which it seeks to serve.

The Selection Committee (Diplomas) of the Institute, appointed under the terms of the Royal Charter and Bye-laws of the reorganised chartered Institute, of which Committee Mr. J. H. Lester, M.Sc., is the first Chairman, has unanimously recommended that the first Diploma to be awarded by the Institute shall be to yourself, as President, and the Council of the Institute unanimously approved of the recommendation. Herewith, therefore, is also presented to you the First Certificate of election as a Fellow of the Textile Institute.

The Council desires to record its deep sense of admiration of your untiring zeal and practical help not only to the Institute but to many causes with which your name and service are prominently identified—causes calculated to promote the advancement of the textile industry and the general well-being of all concerned therewith.

(*Signed*) John Crompton, *Chairman of Council.*
Wm. Frost, *Honorary Secretary.*
T. Fletcher Robinson, *Honorary Treasurer.*
J. D. Athey, *General Secretary.*

The presentation of the Fellowship was then made amidst applause.

Mr. Emsley, in replying, expressed his appreciation of the grant of the Fellowship, which, he said, he would treasure to the end of his days, and would also be an inspiration to his grandson. He hoped that eventually the Institute would see to it that its Fellowships were endowed in order that those who were suitable and were not engaged in the industry itself could continue their studies.

Mr. George Garnett (Vice-president), in proposing the toast of "Our Guests," said the textile industry was out for a higher status, and their guests could help them in achieving that object, representing as they did, Parliament, the municipalities, the education authorities, various branches of industry, banking, and the law. He thought there was a brighter prospect before the industry because it would be based in future on a wider knowledge and a greater spirit of co-operation.

The toast was responded to by the Lord Mayor of Bradford (Ald. J. Stringer), Sir James P. Hinchliffe (Chairman, West Riding County Council), Mr. H. Sutcliffe Smith (Chairman, Colour Users' Association), and Lieut.-Col. A. Gadie, M.P. for Central Bradford.

Mr. H. Sutcliffe Smith mentioned as an instance of the enterprise of the wool textile trade that in three or four branches of the Bradford Dyers' Association no less than 50,000 patterns had been dealt with during last year. That showed that Bradford was on the look-out for new things to tempt the buyer. He paid tribute to Mr. Emsley's efforts not only in connection with the Charter but also in the movement to bring the wool textile industry into closer touch with the retailer. A further step in that direction was to be taken the following day, when they were going to meet the wholesalers. There had been bitter complaints that more sympathy was shown to French sellers than British sellers, and they hoped at that meeting to remove misconceptions and create an atmosphere in which British goods would be better received.

Lieut.-Col. A. Gadie mentioned that in December 20,500,000 gallons of water were consumed in Bradford, against 17,800,000 gallons 12 months previously, and attributed the increase to trade requirements.

The gathering concluded with a vote of thanks to Mr. Emsley for presiding, proposed by Mr. John Robinson.

London Section

Meeting at the Clothworkers' Hall, Mincing Lane, London, 15th November 1925. Chairman, Mr. C. B. Gwynn.

THE FINISHING OF COSTUME CLOTHS

Opening the proceedings, the Chairman said that he had himself, for the past twenty years, represented the interests of a great dyeing association which would be well known to many of those present. Unhappily the dyer and finisher was the man to whom the cloth went last, and the consequence was that if there was a fault in a piece of cloth, it was always put down to the poor dyer. He contended that to make a piece of cloth absolutely perfect in every respect would be a wonderful thing—a piece of cloth perfect in every respect from the point of view of weaver, dyer, and finisher. He hoped that after they had heard the lecturer they would be a little more sympathetic towards the dyer. If any of those present were in Yorkshire at any time he extended to them a very hearty invitation on behalf of his Association to go over their dye-plants, and he thought they would come away with a different impression.

Capt. H. Jennison, M.C., the lecturer, then said—To-night I propose to deal with the finishing of light weight dress goods, but at the very outset may I point out that the term "finishing" is very broad in its application, and it is my intention to start at the very beginning, leading to the finishing processes later, since, paradoxical as it may seem, the best finishes can only be obtained by the greatest care being taken in the preliminary treatment. The following short résumé may indicate how the ultimate results can be affected before the cloth reaches the dyer or finisher. At the very commencement, the sorting of the wool has a bearing on the ultimate handle of the cloth, since, as all of us know, botany wool gives a much softer handle than cross-bred. Combing also has its effect, the longer hairs giving us worsted cloths, and the shorter hairs woollens. In spinning, the degree and the amount of twist is of great importance in the production of cloths; any variation in twist may result in streakiness or weft bars. The choice of a suitable non-drying oil for use during combing and spinning is also of the greatest importance to the dyer, since a dried or semi-dried oil can only be removed with the greatest difficulty, giving rise again to "barriness," or streakiness. During weaving, mechanical faults are liable to occur which, if not corrected before the piece is dyed and finished, may give rise to faults then too late to remedy. The pieces must therefore be examined carefully at the weaving shed, and any faults discovered mended by girls. The pieces will now be ready for handing to the dyer, but before we go any further, it would be as well to give you a rough idea of the organisation of the dyeing and finishing industry in general.

Speaking broadly, the industry may be divided into three groups. First, there are a few self-contained firms who buy wool in the raw state, from which they manufacture cloth, and afterwards dye and finish it. Secondly, there are a large number of firms who dye and finish goods on commission—this means that the cloth to be treated never really belongs to these commission dyers and finishers, but simply passes through their hands, afterwards being returned to the customer or being delivered elsewhere at his instruction. Lastly, there are several small firms who dye cloth on this same commission basis, afterwards handing it on to other firms to be finished. The majority, however, may be grouped in the second class, which dyes and finishes cloth on a commission basis, and it is from this point of view that we shall deal with the cloth.

One of the first steps generally taken when new cloths have been designed is for pattern lengths to be made, which can be treated before any pieces are manufactured, in order both to note the finished result and to check the designer's calculations of shrinkage for costing purposes, after which the cloths are shown

as travellers' samples, from which you gentlemen buy your season's goods. Orders, may we hope ! are now placed and goods are put into work, and after weaving and burling and mending, they are in most cases sent to the dyer to be held in his greyroom until instructions for colouring up have been received. This may entail the storage of as many as twenty thousand pieces in the dyers' greyroom. Naturally, as these pieces do not belong to the dyer, every precaution must be taken to preserve them from damage or loss, the chief danger of course being from fire, and this means that very heavy insurance premiums have to be faced.

The lecturer then proceeded, by the use of slides, to describe the various processes employed in dyeing and finishing; he mentioned first the process known as "crabbing" to which botany cloths are generally subjected in, which consists in essential of winding the cloth under tension through troughs of boiling water on to rollers. Cross-bred cloths require the further treatment of "steaming" which process involves the use of a perforated iron cylinder upon which the fabric is wound. Steam is then blown through the cylinder and outwards through the piece. The better class fabrics are then put through a "scouring" process, to remove the 3 to 4% grease or oil they contain. Pieces destined for light or pastel shades require the utmost care, and it has to be said that manufacturers, as a whole, take every precaution against dirtying such goods. Samples were produced by Captain Jennison to illustrate the difference between the grey cloth and the prepared and scoured article, and he pointed out how much closer in texture the cloth had become, thus giving a fuller and softer handle. The "milling" process employed in the production of such cloths as cheviots, estamines, velours, vicunas, &c., was next described, and samples shown of cloths which had been milled and "stock" milled. After scouring or milling, the pieces contain from 100% to 150% of water, which renders them difficult to handle. As a rule a large proportion of this water is removed by a hydro-extractor, which process was described by the lecturer. The case of goods coloured from the grey, either with acid wool colours or, for faster colours, by chrome-fixed colours, constituted the next part of the lecture, and the function of a mordant was described at this point. The method followed in indigo dyeing was then outlined, and it was pointed out that while in the vat no part of the cloth was allowed to come above the surface of the dyestuff, as any part so exposed became darker in colour than the bulk. A slide of a typical indigo vat was displayed and its variation from an ordinary dye-vessel pointed out. To prevent "rubbing," the pieces are treated in a scouring machine with Fuller's earth.

Assuming that the dyeing process is completed, the dress goods would now be ready for drying, but in the case of suitings and such cloths as venetians it is often necessary to treat the pieces further in order to obtain the finish required. After dyeing, or any subsequent treatment, the cloth is again hydro-extracted to remove all surplus moisture, after which it is ready for drying. There are two alternative methods of drying the cloth, the first being to run it over a series of steam-heated cylinders, and the second to dry it in a heated chamber, the cloth being held at the selvages by means of pins, which can be adjusted for width. The latter method is generally employed for better quality cloths, since it imparts a much nicer handle and has the advantage that it is possible to control the width at which the pieces require to be dried. The treatment given to the pieces so far cannot be regarded as very gentle, and it is hardly to be expected that even the best of cloths should emerge from the drying machine without being slightly ruffled, so much so, that in practice it is found necessary to clear the face of the cloth by cutting or cropping. A cropping machine consists of a circular rotating blade very similar to that used in a lawn mower, except that more blades are employed and that it requires to be set with a very much finer degree of accuracy, in fact, in actual practice, a cropping blade will shear a sheet of the thinnest tissue paper procurable. The cloth, held under tension, passes over a frame called the bed, and the blade is adjusted to the

cloth so that all the rough hairs are cut away, leaving a very much improved material. This bed is hollow, so that if any small defects are present the cloth will have space to sink slightly below the level of the knife edge, and in this way avoid the danger of cutting a hole into the piece. Other machines are fitted with a solid bed, which allows much closer setting of the blade to the cloth, but raises the danger of small holes being cut wherever a knot occurs, since with a bed of this type the cloth cannot sink and the blade cuts through the knot; these machines may have as many as four blades. The pieces are then examined for evenness of dyeing, shade matching, and general satisfactoriness. They then pass on to the burlers and menders. Discussing this part of the industry, Captain Jennison emphasised the enormous increase in the employment of burlers and menders, and instanced figures of one concern in which these wages had risen 492% since 1904, and of another firm which in 1910 paid £3,792 for this work and in 1923 £12,725.

The lecturer proceeded to describe the "finishing" of such fabrics as serges, gabardines, poplins, &c., pointing out that "finishes" for other cloths were only modifications of the process he proposed to describe. In the dry-blowing or decatising process, the cloth, open width, is wound on to perforated cylinders between layers of heavy weight cotton wrapper. Steam is then blown through the cloth, giving it a firm handle, and at the same time removing all creases which may have developed during the perching and burling. The pieces are then stamped on the selvage according to the finish being given. This is becoming the general custom, the main feature being the security given to the customer, since no dyer or finisher can afford to fix a stamp on his cloth unless he is confident that it will give satisfaction. After stamping, the cloth is rigged, which means that it is doubled along its length, one list being superimposed on the other, after which it is ready for pressing. In carrying out this treatment the cloth is folded between sheets of specially prepared cardboard, so that they are in contact with both back and face of the material. They are then placed in a press consisting of a base, below which is an hydraulic ram. Each press will hold from 14 to 16 pieces, one above the other. Heat is necessary in order to obtain the result required, and papers are warmed by means of steam-heated metal plates before they are inserted into the pieces. Pressure is now applied, and after the pieces have remained a few hours, with a pressure of from one ton to twenty-five hundredweights per square inch on the hydraulic ram, they are taken out and "turned," which means that the papers are taken out and replaced in such a position that the previous fold of the cloth is situated in the centre of the press-paper. If this were not done, a dark mark would be visible across the piece where no pressure had been applied. The pieces are then reinserted in the press and a pressure of two tons per square inch of ram surface is applied for a further period, by which time the papers will have gone cold and the cloth will be well set. If the cloth could now be examined it would be found to be glazed both on the back and the face, and in this condition would be quite unsuitable for sending into the market. It is therefore necessary to give the face a dull appearance, which is produced by passing the cloth, face downwards, over a box containing live steam, until a perfectly level dull finish is obtained. This may entail as many as four passages over the steam box, in order to obtain the desired effect, gentle steaming being essential in order not to affect the back of the cloth too much, and it must be left with a small amount of press on in order to give a nice handle. The goods are then left under their own weight with a layer of metal plates on top of the pile of pieces.

The pieces are now ready for delivery, unless a still better finish is required, which is produced by "London shrinking." To produce this finish, the cloth is led at open width between wet blankets which wet the cloth, and remains between these blankets until a heating action takes place, and the cloth begins to steam of its own accord. This treatment leaves the cloth in such a condition that, when hung up to dry, naturally, without any tension either on the width

or the length, all the stretch produced in the various processes is eliminated, and the cloth is in its natural state, thus ensuring that in the subsequent making up no shrinkage can take place, and the cloth will keep its shape. The pieces are now re-pressed, steamed, and laid as before, severity of the treatment of course being reduced considerably, after which they are again ready for the market.

This method of finishing, with slight variations, may be regarded as the standard for all classes of gabardines, serges, poplins, and variants such as covert cloths, panamas, &c. When we come to velour cloths, estamines, and faced cloths, we must return to the stage at which the cloth left the dyeing machine. The cloth will have been milled before dyeing in order to give it solidity, and it is now raised to produce the cover associated with this class of material. This is done by brushing the cloth with wire brushes which raise the fibres from the ground, giving the pile effect. A portion of this pile is then cut away on a cropping machine, after which the cloth is again run over the raising machine, in this way thickening the pile. This cycle of operation is repeated until the desired result is obtained, after which the cloth may be pressed lightly in order to give it a smooth handle. These, then, are the main operations generally employed for dyeing and finishing cloth, different results being obtained by slight variations in the various processes.

The Hon. Secretary of the Section, Mr. A. R. Down, thanked the lecturer for an extremely interesting paper. He regretted the absence of Mr. Edwin Wigglesworth, who had another engagement of long standing. He personally would not fail to take advantage of Mr. Gwynn's kind offer when next he was in Yorkshire. He had always thought that dyers were a somewhat secretive folk and was glad to find that this was not so in the case of the Association with which Mr. Gwynn was connected.

The vote of thanks was seconded by Mr. P. J. Neate and, after a brief reply from Captain Jennison, the proceedings terminated.

Irish Section

Meeting at the Municipal College of Technology, Belfast, 5th February 1926, *Mr. F. Anderson in the chair.*

THE USES OF ARTIFICIAL SILK IN THE PRODUCTION OF TEXTILE FABRICS

Though Textile Institute meetings at Belfast do not take place with great frequency, yet the meetings organised there are usually associated with a highly satisfactory measure of support and enthusiasm. On the evening of the 5th February, Mr. A. B. Shearer, F.T.I., of Manchester (Official Lecturer for Messrs. Courtaulds, Ltd.), contributed a lecture on "The Uses of Artificial Silk in the Production of Textile Fabrics." In connection with the lecture an exhibition of fabrics and yarns, by the firm named, took place on the 3rd, 4th, and 5th February. The events took place at the Municipal College of Technology, excellent facilities having been generously granted by the Technical Instruction Sub-committee of that institution. The Principal of the College (Professor J. Earls) took an active interest in the fixture, whilst Professor F. Bradbury, of the Textile Department, assisted in every possible way. The exhibition was attended by large numbers of representatives of the textile industry in Northern Ireland and considerable interest was taken in the proceedings.

The lecture by Mr. Shearer took place on the Friday evening in one of the lecture halls of the College, when the attendance was even larger than had been anticipated.

Mr. Frank Anderson (Portadown) presided, and alluded to the progress of

common meeting ground for the various branches of the textile industry for the consideration and discussion of technical and scientific problems relating to the various fibres and their products. The need for the Institute had been amply demonstrated. The present meeting was the first held at Belfast since the Institute obtained its Royal Charter, and he was pleased to be able to state that of the diplomas which the Institute had already granted to members, under the terms and powers of the Charter and Bye-laws, one or two had already been secured by members in the Belfast district. With regard to the subject of the lecture, the developments in artificial silk had certainly been phenomenal and had introduced a new factor affecting the demand for yarns and fabrics. The artificial filament was assisting greatly developments in composite fabrics, particularly in the cotton and woollen trade. In the linen industry there had not been so much replacement or substitution, but demands which had arisen were being met. An important problem, perhaps, was that of keeping pace with the developments in yarn and fabrics with the retention of their particular plant.

Mr. A. B. Shearer, in the course of his lecture, after referring to the introduction of the artificial filament, said there was usually some good and sound reason for any innovation which took place in regard to the raw material of an industry. Fashion and the demand for increasing variety of ornamentation in fabrics were doubtless responsible for the production of what was to-day known as artificial silk. Fashion had brought about a marked diminution in the quantity of material required, and this diminution had brought about a searching for extended variety. Lustre was an important consideration in the securing of decorative effects, and as silk was somewhat prohibitive in its price, the new material was forthcoming to meet the demand. The artificial silk industry had grown in the lifetime of most people present, and its growth had really been enormous. Great Britain was the second largest consuming country in the world and advanced from two million pounds weight in 1913 to about four million in 1919. In 1924, the consumption was about 28 million pounds, and last year it must have been at least 35 million pounds. The world's production had proceeded apace. In 1922, it was about 80 million pounds, 1923 97 million, 1924 140 million, and in 1925 180 million pounds. So far, the amount was very small when considered as a textile fibre. Nevertheless, real silk was an important textile industry, and in 1924 the world production of natural silk was only 86 million pounds. Therefore, in 1924 the production of artificial silk was nearly twice that of the real. To-day, he considered it was reasonable to regard artificial silk as the third most important raw material for the textile industries, and it had jumped into this position in a very few years. He saw no reason why, eventually, artificial silk should not be produced which would be as strong as silk and be the strongest fibre available.

It was not difficult to deal with from the manufacturers' point of view, given a thorough understanding of its properties and the properties of the other fibres which were used with it. Greater scope had been given to designers by its possibilities in regard to new textures, and some highly interesting materials were now being produced, more particularly in Yorkshire, from mixture yarns. Great care should be taken that surfaces with which artificial silk had to come into contact during manufacture should be cleared of rust and inequalities. Even slight friction was detrimental, and, inasmuch as lustre was one of its outstanding features, it followed that the minimum of handling should be aimed at.

Discussion

The Chairman said the wide difference in behaviour of artificial silk, as compared with flax, presented considerable difficulty, and, in combining artificial silk with linen, the difficulty intensified in progress of manufacture. They were indebted to Mr. Shearer for his address, not only on that occasion, but for

the useful discussions he had engaged in earlier in the day with visitors to the exhibition.

Replying to questions, Mr. Shearer said he preferred to retain an open mind as to combination of artificial silk and flax. Flax, in certain respects, was almost too much akin to artificial silk, and this had the effect of the two yarns slipping on each other. Wool was entirely different; it gripped anything in contact with it, whilst it felted easily. Careful tensioning was absolutely necessary. Viscose behaved very differently from flax, and the stretch and regain of the yarn as it went through had to be fully considered. This consideration was important because the introduction of artificial silk was leading to keener appreciation of the properties of the fibres with which the industry was already accustomed. It was to be remembered, too, that what might at first be regarded as a fault might be turned to good account so as to yield an effect which the designer desired, and the fault might be turned into a virtue.

Asked if operatives experienced difficulty in dealing with artificial silk, he said that greater care generally meant greater cleanliness. Generally speaking, its manipulation was attractive to the operative.

Replying to a question as to occurrence of "bright picks," he said the whole matter boiled down to consideration of tensioning. Properly spun viscose should be level and have level dyeing qualities. In combining artificial silk with linen, the linen should be as near to bleached as possible before combination. Dry atmospheric conditions were desirable, for the greater the humidity the less was the working strength of the viscose. Regarding a question as to sizing or dressing, the lecturer said it was obvious that ordinary size (starch), which had no lustre, should not be used. Ready sized warps were now available.

Mr. J. D. Athey, General Secretary of the Institute, moved a vote of thanks to the Lecturer, to the Chairman, and to Mr. Yates (Messrs. Courtaulds, Ltd.) for their services, and in doing so referred in some detail to the aims of the Institute and the conditions governing the grant of diplomas.

Professor F. Bradbury seconded, and said there had been abundant testimony to the fact that the three days' effort on the part of the Institute at Belfast had been thoroughly worth while.

The vote was heartily accorded.

YARNS FOR THE HOSIERY TRADE

Conjointly with the British Association of Managers of Textile Works, a meeting was held at the Institute, Manchester, on Saturday, 23rd January, when Messrs. J. Chamberlain (Technical School) and J. T. Stokes (Secretary of the Textile Society), both of Leicester, gave a lecture on the above subject. Mr. Chamberlain dealt with the properties desirable in yarns for the hosiery trade. The ideal yarn, he said, would possess uniformity, good covering power, plasticity, elasticity, cleanliness, lustre, and good dyeing and bleaching properties. In addition, it should possess high tensile strength, and should be unshrinkable. He then dealt with the classes of yarns used as determined by the fibres from which they are made, and passed on to describe the part played by machines in relation to the choice of yarns to be employed in knitting processes. His next and last topic was the marketing of yarns.

Mr. Stokes, in a very practical and direct way, put before all present his views as to the possibilities of Lancashire developing a trade with Leicestershire in hosiery yarns. Extended credit demands, difficulty of securing the exact class of yarn required, and special demands as to winding, he mentioned as obstacles. To any spinner desiring to go in for hosiery yarns, he urged regularity in counts, extra care in regard to cleaning and carding, and delivery on cones.

It was stated at the meeting that it was hoped to continue the discussion at a meeting at the Textile Institute on Saturday, 20th March, the last day of a three days' exhibition of knitted fabrics and yarns.

NOTES AND NOTICES

The Council of the Institute

At the February meeting of the Council (17th inst.) at Manchester, an unusually lengthy agenda was submitted and the business was disposed of with comparatively marked dispatch. Mr. John Crompton (Chairman) presided, and there was not a large attendance, the tendency towards small meetings, as a result of the experiment of holding meetings monthly in place of quarterly, persisting. It was an obvious advantage that the Finance Committee now having been resuscitated had paved the way to facilitating the conduct of the business. An important item was the recommendation of the Finance Committee for certain rearrangements in regard to the staffing of the London offices of the Institute, and the Council readily acquiesced in the proposal that Mr. William Frost (Chairman of the Finance Committee) should confer with the London Section Committee and present definite proposals on the subject. A recommendation from the London Section Committee that a contribution should be made to the funds needed in connection with the special Inquiry into Relationship of Technical Education to other forms of Education and to Industry, of which the Rt. Hon. Lord Emmott, G.C.M.G., is Chairman, was considerately received, and it was agreed that the Institute should contribute ten guineas. It was reported to the Council that the Cotton Textile Industry Committee (British Empire Exhibition 1924) had remitted to the Institute, per the Hon. Secretary, Mr. Frank Nasmith, a cheque value £83 4s. 7d., being surplus of the funds of the Cotton Textile exhibit which the Committee had had pleasure in voting as a donation to the Foundation Fund of the Institute. This acceptable gift was gratefully received and the Secretary to make suitable acknowledgment on behalf of the Council. The fact may be stated that in some measure at any rate the gift represents acknowledgment of the facilities granted to the Committee in question for the holding of their meetings at Manchester. The Council decided that the Hon. Treasurer, Mr. T. Fletcher Robinson, should proceed with investment of the £100 odd now standing at the bank to the credit of the Foundation Fund. One other item may be mentioned—that the Council received with the greatest regret the intimation of Dr. W. Lawrence Balls that in consequence of removal from the Manchester district he proposed to resign membership of the Council and Committees of which he has been long a member, and it was decided that Dr. Balls should receive the warm thanks of the Council for his past services. The matter of the next Annual Conference at Buxton was also mentioned at the meeting, and the Council were gratified to learn that Sir William H. Bragg, K.B.E., F.R.S., had kindly consented to contribute the annual Mather Lecture on Thursday, 27th May, at the Conference at Buxton.

Forthcoming Election of Council

In response to the issue of nomination forms in respect of the forthcoming election in connection with the Council of the Institute, the General Secretary reported to the Council that sufficient nominations were now to hand to make it quite certain that a contested election will take place. Thirteen nominations had been received from individual members and, including nominations by the Council, the number is brought to sixteen for the ten vacancies. Nomination forms have been sent out to all members, but members are asked to note that the final date for receipt of nominations is 16th March. All nominations for Vice-Presidents and Ordinary Members of Council should be made on the special forms provided, and additional nomination forms will be forwarded to members on request. Every nomination form must relate to one vacant place only and must be signed by two members of the Institute and also by the nominee, who must also be a member of the Textile Institute. It is important to note that in addition to individually secured nominations, the Council itself is empowered

to nominate. In due course voting papers will be issued containing the names of the candidates and distinguishing those nominated by the Council. These will be sent out at least 14 days prior to the date of the Annual General Meeting, 21st April, all voting papers having to be returned to the General Secretary at least four days prior to the said meeting.

The Publications Committee

Items of general interest to members arise from time to time in the deliberations of the Council and of Committees of the Institute, and it is one of the functions of these "Notes and Notices" to place on record such matters. At the February meeting of the Publications Committee, it was decided to institute a feature for the Proceedings Section of this *Journal* by which obituary notices would be published. The first such notice appears in this issue—Professor William Myers. In this way, it is hoped to place on record tributes to the memory of any prominent member of this Institute who may have passed away. Under the heading "Section Activities," the January issue contained a reference to a new development which owes its inception to the Publications Committee. The reading of papers, ultimately to appear in the Transactions Section of the *Journal*, at Institute meetings, would, it was thought, afford technical and scientific interests an opportunity to discuss common problems from their respective points of view. This may be said to have characterised the meeting held on 12th February at the Institute, though on this occasion no doubt the discussion became rather too scientific in terminology for close following by all; none the less the requirements of the practical side of the industry were kept well in sight throughout. For this, credit must be accorded to the Chairman of the meeting, Mr. Percy Bean, whose plea throughout was for the view-point of the spinner or weaver never to be lost sight of. But, from the discussion, two main points emerged—first, that scientific workers should agree upon working definitions, and, secondly, that the practical man should express as clearly as possible exactly what qualities or properties he desires in his yarns or materials. That these points have been made before more than once is well known, but the meeting under review brought out two practical and specific examples. The first was that generally-accepted and understood definitions of "elasticity," "pliability," and "plasticity" should be sought, and, secondly, that careful investigation should be made into the real desiderata for yarns to be used in weaving both generally and specifically from the point of view of the cloth under construction. Are yarns to be strong from the point of view of their direct breaking strength, or to be elastic, or to be pliable? Not that one of these qualities is to be sought to the exclusion of the others, but that one may be preferable to the others in the light of the behaviour of yarn in the loom. Having settled that point, if it can be settled yet, it would probably be desirable to set about securing some simple method of measuring elasticity or pliability, comprehensive alike to the shed manager and to the technical director. Possibly, even probably, many engaged in the industry consider that these points are already settled—that they have a means of judging or measuring the qualities desired. The discussion on 12th February showed very plainly that such knowledge was not universal. Only by joint discussion of these similar problems by those really concerned can satisfactory terms of definition be arrived at, and adequate means of measurement and expression of measurement be secured. It is hoped that such discussions may soon be arranged in addition to the reading of further papers of a technical and scientific character.

Linen Industry Research Association

It is announced that Dr. J. Vargas Eyre is relinquishing the Directorship of the above-named Association, which has its Research Institute at Lambeg, Co. Antrim. At the end of March, Dr. Eyre is to take up similar duties for the Distillers Co. Ltd., with a view to the development of a central research

institute and the building up of a new research organisation for the interests indicated—in fact, to carry out a somewhat similar scheme to that which has been carried forward in connection with the linen trade. In consequence of the appointment, the Directorship of the Linen Industry Research Association will be vacant after 31st March. Dr. Eyre states that he has found it extremely difficult to decide upon the change in question, the more so on account of the extremely cordial relations which he has experienced with all concerned with the Linen Research Association, and also in view of the splendid support which his staff has extended to him on all occasions. It may be here stated that Dr. Eyre's association with this institute, and particularly his services on the Publications Committee, for several years past have been greatly esteemed, and officers and members of the Institute, whilst regretting his transference to another industry, will wish him every success in his new sphere of activities.

Technical Education and Industry

At the beginning of 1925 and as the outcome of a general meeting of interested persons, a Committee was formed in London under the chairmanship of Lord Emmott, and with Mr. J. Wickham Murray as Secretary, to inquire into the Relationship of Technical Education to other forms of Education and to Industry. The Textile Institute was invited to nominate two representatives for this Committee, and, accordingly, Messrs. E. B. Fry and A. E. Garrett, members of the London Section Committee, were appointed delegates. At a meeting of this Committee on the 18th December 1925, it was reported that the Secretary for the Board of Education had clearly indicated his sympathy with the Inquiry, and also that certain arrangements were being made to prevent overlapping between this Committee and H.M. Government's Committee on Education and Industry. It was agreed to pursue the Inquiry by means of questionnaires, a special questionnaire to be prepared to which Universities should be invited to reply. Mr. E. B. Fry, reporting to the London Section Committee of the Textile Institute on the work done by this Committee, states that "this Inquiry is now getting into good shape, and a special Executive Committee of six has been appointed to draft finally the questionnaire which is to be sent out to all the Technical Schools and Colleges, the Universities, Education Authorities, and representative firms selected from various classes of industry. Answers to the questions will be collated and reported upon to the General Committee for further consideration and action." The wide scope of the Inquiry, and its obvious importance to the vital question of technical education, render its proceedings a matter of serious interest, and a report of later work and conclusions drawn from the questionnaire should prove of great value to the textile industry.

London Offices of the Institute

The Institute's premises in London, which have proved convenient in many ways to members visiting London, and which serve as offices for the London Section, have for the last nine months also given accommodation to the Association of Special Libraries and Information Bureaux, an arrangement which has modified the Institute's annual expenditure on its London premises. More recently, an additional "paying guest" has been welcomed at 38 Bloomsbury Square, the British Institute of Industrial Art having come to terms with the Council for part use of the rooms. This organisation aims at effecting a closer co-operation between Art and Industry, and has held exhibitions from time to time at important industrial centres with this object in view. It works in close co-operation with the Board of Education and the Board of Trade, and has a consultative panel of some two hundred Fellows, elected for their services to art in its industrial application. The Textile Institute has supported the British Institute of Industrial Art from its inception, and the present arrangement for sharing premises is agreeable to both organisations.

Isidore Spielmann Memorial

The Governors of the British Institute of Industrial Art have decided to apply the legacy of £50 bequeathed by the late Sir Isidore Spielmann (who was a Governor of the Institute from its foundation until his death last year) to form the nucleus of a Memorial Fund to be called after his name. This fund will be used for the occasional purchase of works of modern British Industrial Art considered worthy of a place in the Permanent Collection of the Institute which is now exhibited in the North Court of the Victoria and Albert Museum. All who sympathise with the above object and who desire in this way to express their appreciation of Sir Isidore Spielmann's great services to British Art and Industry are invited to contribute to the Isidore Spielmann Memorial Fund. Communications should be addressed to the Hon. Treasurer, 38 Bloomsbury Square, W.C.1.

Institute Membership

At the January meeting of the Council of the Institute, the following applicants for membership were elected—Phineas Bentley (Mill Manager), Pleasley Works, Mansfield, Notts.; Charles Bownas (Textile Designer), 22 Harrogate Avenue, Sedgley Park, Manchester; Harold Brookes (Textile Designer), 139 Manchester Road, Walkden; C. K. Buckley (Principal), Government Textile School, Cawnpore, India; H. O. Croasdale (Cotton Student), Gayford House, Colne; Gerald Dod (Engineer), 35 Little Peter Street, Manchester; James Duckworth (Assistant, Weaving Department, British Celanese, Ltd., Spondon), 18 Merchant Avenue, Spondon, near Derby; C. B. Gwynn (Director, Bradford Dyers' Association), 128–129 Cheapside, London, E.C.2; W. J. Hall (Research Physicist), 23 Middleton Road, Ilkley, Yorks.; L. Meunier (Professor of Chemistry), 67 Rue Pasteur, Lyon, France; Gerald Park (Assistant Preparation Department Manager, Cotton Weaving Mills), 450 Blackburn Road, Darwen; Srinibas Shaha (First Assistant), Government Textile School, Cawnpore, India; L. B. Sutcliffe (Textile Analyst), Prospect House, Park View Road, Bradford; E. G. Taylor (Cotton Student), 96 Park Drive, Colne; C. A. Thirumudiswamy (Weaving Master, Sitaram Spinning and Weaving Mills, Ltd.), Trichur (Cochin State), South India; C. W. Woodman-Cooper (Silk Salesman), Elmcroft, Pinner Road, Harrow-on-the-Hill; S. V. Naik (Student), c/o Thos. Cook & Sons, London, E.C.4; Samuel Catterall (Carding and Spinning Manager), Elgin Mills, Cawnpore, India; Frank Hopkinson (Director, Bradford Dyers' Association), 41 Leylands Lane, Heaton, Bradford (Yorks.); Fred Kenyon (Overlooker), 97 Chapel Street, Leigh; C. T. Nicholson (Cotton Piece Goods Salesman), c/o Broome & Foster, Ltd., Manchester; H. Duncan Robertson (Weaving Master), Binnyston Gardens, Bangalore City, South India; Arthur Saville (Manager, Francis Willey & Co.), Duke Street, Bradford, Yorks.; George Shackleton (Weaving Manager), 22 Broomfield Street, Queensbury, Bradford, Yorks.; Wm. Smethurst (Textile Designer), 23 Shaw Street, Bolton; John Tomlinson (Dyeing Expert), China Dyeing Works, Jessfield, Shanghai, China.

At the February meeting of the Council of the Institute, the following applicants for membership were elected—George Baxendale (Operative Cotton Spinner; Representative for Leigh Technical Union), 183 Hope Street, Leigh; David Robert Christie (Lecturer on Textile Technology), Scottish Woollen Technical College, Galashiels; Richard H. H. Dawson (Salesman, Textiles), 36 Park Hall Road, East Finchley, London, N.2; Fred Greenwood (Mill Manager and Teacher of Textiles), 107 Tweedale Street, Rochdale; Ernest V. Haigh (Engineer and Cotton Mill Manager), c/o Messrs. John Hetherington & Son, Ltd., Pollard Street, Manchester; Robert A. Hill (Chemist, Silver Springs Bleaching and Dyeing Co., Congleton), 2 Malvern Villas, Hightown, Congleton, Cheshire; Herbert Holroyd (Representative for the Huddersfield Textile Society), Longroyd Bridge Mills, Huddersfield; A. S. Mombert (Managing Director, c/o A. & S.

Henry & Co. Ltd., Bradford), Tablehurst, Park Drive, Heaton, Bradford, Yorks.; Gilbert H. Orton (Textile Buyer), 32 Woodlands Road, Crumpsall, Manchester; F. W. Peerless (Clothworker), 61 Old Street, London, E.C.1; Frederick T. Peirce (Textile Research, Shirley Institute), 63 Kingston Road, Didsbury, Manchester; W. P. Richmond (Mill Managers' Assistant), 21 Bentley Street, Nelson; Fred Scholefield (Dyeworks Manager and Chemist), c/o Burgess, Ledward & Co. Ltd., Walkden, Manchester; George Scott (Hosiery Manufacturer), Messrs. Peter Scott & Co. Ltd., Hosiery Manufacturers, Hawick, Scotland; Walter M. Scott (Textile Chemist), c/o Cheney Brothers, South Manchester, Conn., U.S.A.; Harold D. W. Smith (Textile Chemist and Technician), 75 West Thirty-third Street, Bayonne, N.J., U.S.A.; John Smith (Pattern-room Foreman, and Textile Teacher, Bolton Evening Classes), 22 Old Clough Lane, Walkden, near Manchester; J. Woodhead (Mill Manager), Firth Mill, Skipton, Yorks.; H. J. S. Dewes (Manufacturer of Specialities of Oils and Fats for the Textile Trade), Heathfield, Cross Lane, Latchford, Warrington; Norman Jepson (Sales Manager, Cotton Spinners & Manufacturers), Talbot Villas, Talbot Street, Glossop; G. H. Thompson (Mill Manager and Director, Cotton Spinning & Doubling), 146 Coppice Street, Oldham; J. McKay Adan (Textile Designer and Representative), 52 Bedford Place, Aberdeen, Scotland; Donald Wilson (Textile Lecturer, Preparing, Combing, and Spinning; and Worsted Spinners' Order Clerk), 15 Harker Terrace, Stanningley, near Leeds.

OBITUARY

Prof. William Myers

By the sudden death of William Myers, Professor of Textiles in the College of Technology and the University of Manchester, technical education in this country has lost one of its most striking personalities. Though he had specialised in the processes of weaving and allied subjects, his knowledge extended over the whole field of textile technology. His place in the hearts and minds of those who knew him does not rest upon his knowledge and his teaching but upon the broader and more enduring foundation of his humanity. From the moment a student presented his admission card to the time when he left the College to enter the textile industry, William Myers was his friend. William Myers was loyal not only to those under his charge but also to those officially above him. The very word loyalty was indeed almost a watchword with him, and to him disloyalty was a crime. Through all the changing adjustments which progress demands and the many misfortunes which befell him he showed a cheerful face to the world. The world would be a much happier place if everyone had his sunny temperament which made difficult tasks appear easy, without in any way underestimating their magnitude.

When it would have been far easier to reject the application for admission to an educational course of a student who had failed to comply with all the comparatively inelastic regulations required for qualification, William Myers opened the door for him with his golden key, "Well, we must do what we can for this man." Many an ex-service student of the College owes his post-war education there to Myers' fatherly sympathy. To see numbers of old students calling on him for advice; to hear the students' whole-hearted laughter at his jokes in class, accentuated by interspersed periods of tense silence; to read the letters of highly placed officials in the textile industry seeking his help either in technical matters or in suggesting suitable men for their staffs; to note the pleasure with which he gave out to all and sundry the fruits of many years of experience; to listen to his criticism or praise, given without fear, favour, or hope of reward, was to know something of William Myers. No one, be he saint or sinner, lord or commoner, educated or uneducated, could live with him without loving him; he endeared everyone to him and grappled his friends to his heart with hooks of steel. Having climbed the ladder of success, he never forgot those who had helped him to rise from rung to rung. Though he spoke his mind when occasion demanded he was really shy, modest, and acutely sensitive, with the result that his

pointed and forcible expressions always commanded attention and carried conviction.

The Textile Institute has been deprived of one of its staunchest supporters by his death. While living, he was always missed if absent from the Institute Committees of which he was a member, though this happened but rarely. His place in the activities of the Institute will be hard to fill, and one can only hope that those he has left behind will carry on his work in the same spirit in which he began it. His mind was in sympathy with both the practically and the theoretically inclined, and no one has done more to strengthen the bonds linking those who practise, profess, or teach textile technology.

Enthusiastic, untiring, and well-balanced in mind, he never spared himself, putting every ounce of his energy into his work. His sudden death, after he had occupied the chair of Textile Technology for but three weeks, came as a great shock to all who knew and cared for him, and leaves us with only one consoling thought—that joy in life is not measured in time units but in intensity of living. He lived as became him, actively assisting all who passed his way; he died as became him, in harness, leaving the memory of a big-hearted, kind-hearted, and true friend. —F. P. SLATER.

REVIEWS

Les Soies Artificielles. By A. Chaplet. Gauthiér-Villars et Cie, Paris, 1926 (248 pp. and Index. 3 fr. 75 c.).

This book gives a useful collection of literature mainly taken from patents. After giving an outline of the production of real silk and of the history of the development of artificial silk, the author describes methods of making solutions of cellulose in ammoniacal copper solution.

The information on viscose does not include such practical details as would enable a chemist not already familiar with this process to make viscose silk. The layout of plant is theoretical. Methods of making nitrocellulose and its solutions are given and the recovery of nitric acid and of the organic solvents is dealt with. The chapter on acetate silk deals with patents up to about 1912, that is before the time when acetate silk could be regarded as *un fait accompli*. The unsuccessful attempts to make artificial silk from materials of animal origin are described. Diagrams of plant used in the manufacture of artificial silk are given, but these are taken mainly from patent specifications. The bleaching, dyeing, and finishing of various kinds of artificial silk are dealt with. A method of dyeing acetate silk with diphenyl black is given and mention made of ionamines, azonines, and acetonines for the dyeing of acetate silk. Methods of stenosising artificial silk are given and a few tests illustrate the remarkable increase in wet strength claimed for the process, but the loss of elasticity produced at the same time is not an advantage. The properties of artificial silks of various kinds are dealt with fairly fully, and the statistics of production include the year 1924.

This book is more up to date than many books on the subject and covers a useful field, particularly relating to viscose and nitrocellulose. —W.H.

Artificial Silk and its Manufacture. By J. Foltzer. Translated from the French by T. Woodhouse. Third Edition. Sir Isaac Pitman & Sons, Ltd., London (248 pp. and Index. 21s. net).

The third edition is practically a reprint of the second.

The book deals mainly with the cuprammonium process, with which Foltzer is most familiar. The history of artificial silk is discussed and useful abstracts of a considerable amount of patent literature are given dealing with nitrocellulose, cuprammonium, viscose, and acetate silks. Notes are given on the dyeing of the various kinds of artificial silk and mention is made of the S.R.A. colours. The chapter on acetate silk is liable to give the impression that Celanese is the only kind of acetate silk known, which is of course erroneous. The properties of the various kinds of artificial silk are described and an account is given of methods of making artificial fabrics directly from cellulose solutions. The book is valuable to those interested in the manufacture of artificial silk by the cuprammonium process. —W.H.

GENERAL ITEMS AND REPORTS

Leeds University—Report of Departments of Textile Industries and Colour Chemistry and Dyeing

For fifty years the Clothworkers' Company has "sustained in unbroken continuity" its benefactions to the University in respect of the capital and annual expenditure of the Departments of Textile Industries and of Colour Chemistry and Dyeing. The annual report on the work of these departments made to the Company recently affords not only testimony to the cordial relations existing between the University and the Worshipful Company, but also to the comprehensive schemes of tuition and training in vogue at the University in the departments concerned. In view of the general appeal made by the University in October last the Clothworkers' Company have made a special grant of £18,300 towards the cost of structural alterations and additions to the machinery and equipment, while the annual maintenance allowance made by the Company is to be increased, during the next seven years, from £4,000 to £7,000 per annum. In all the grants from the Clothworkers' Company amount to a grand total of £243,292. It may well be said, in the words of a special resolution of the University Council, that "the Worshipful Company of Clothworkers will take rank amongst the chief founders of the higher education of modern England." Mention must not be omitted of a personal gift by Col. Stephenson Clarke, Past Master of the Company, of £1,000 for the endowment of a scholarship tenable in the Textile or Dyeing Departments. The departmental reports embodied in the general report are indicative of continued activity. In the Textile Department matters of interest to which reference may be made are the exhibit of work, British wools &c., prepared for the Yorkshire Show at Bradford, upon which Professors J. C. Ewart and A. F. Barker delivered addresses. Two special testing instruments have been produced for use in the drawing and spinning of woollen and worsted yarns. Researches are recorded into the "Nature and Properties of British Pedigree Wools," the "Extensibility of the Wool Fibre," and on "The Genetics of Wensleydale Black Sheep." A list of contributions to the technical and scientific literature is also given, as well as particulars of the students attending classes and the awards secured by them. In the Department of Colour Chemistry and Dyeing, as in the Textiles Department, a slight decrease in the number of students is recorded, but it may well be that trade depression has to be looked to for the real explanation of this, while on the other hand it is gratifying to record that the majority of students leaving the Dyeing Department have secured factory appointments. It is natural that the attention of the department has been turned to the problems presented by the dyeing of artificial silks, both alone and in admixture with other textile fibres. Gifts are acknowledged in respect of materials, equipment, and research scholarships, and a large amount of research work is reported, covered by publications of considerable interest, as well as records of work not yet completed. Satisfactory examination results and post-graduate progress are reported, as well as particulars of appointments obtained by students of the department.

British Launderers' Research Association

The annual report of this Association is the first to appear after the end of the initial period of five years that, in the case of such organisations, may be regarded as the inauguration and trial period. From Government funds, upon the advice of the Department of Scientific and Industrial Research, during the first five years the Association received £1 for £1 raised by the industry. The Association commences the second period upon a different basis, having to secure an annually increasing revenue in cash, not promises, from subscribers, to earn an annually decreasing grant from the department. The Chairman of the Council of the Association, Mr. D. E. Benson, in addressing the annual meeting of members, described the new, and previous conditions of Government support, and said that the minimum subscriptions for the year had already been secured, but that further effort was needed to secure the five-year average subscription, so that the gross annual income would not fall off when the grants from Government decreased. Dealing with the work of the Association, Mr. Benson pointed out

that the Director had ascertained that the present system of showing how much water was in a washing machine was unreliable, and had devised an arrangement which gave the required content within a reasonable margin of error. A project for the erection of a special building is described, wherein full-scale tests upon such soiled work as is received by the ordinary commercial laundry can be carried out in order to test the practical value of the results obtained from small-scale experiments. The report of the Director describing the work of the year draws special attention to the publication of a book, "The Control of Laundry Operations," and to a series of lectures delivered at district conferences of the Launderers' Federation. He points out that much work of a fundamental character is being and has been carried out by the Cotton, Linen, Silk, and Wool Research Associations that is of great importance to launderers, and which the Launderers' Research Laboratory would otherwise have had to undertake itself. Five reports were issued during the year dealing with the properties of certain soaps; the production and utilisation of steam in laundries; measurements of loads and detergents in the wash-house; hypochlorite bleach; and the design, construction, and use of a constant humidity room. Several patents have either been taken out or are pending, and in one case at least the device is to be marketed. The Director also outlined his programme of research for 1925-26, in which he includes a study of washing machines and the preparation and use of spirit soaps. Reference is made to the abstracting work carried out for this *Journal*, and to the establishment of an analytical and consulting department.

Cloth Construction

Mr. A. R. Tindall, of Bradford Technical College, speaking on this subject before the Bradford Textile Society, on Monday, 1st February, said that however well grounded he might be in the details of cloth construction, a designer would have little success unless he displayed natural adroitness in the handling of colour in application to the fabrics he sought to make. Related colours were, comparatively speaking, safe combinations to handle and could be relied upon, when judiciously used, to produce satisfactory patterns. Complementary colours, on the other hand, were considerably limited in their sphere of usefulness, due to their capacity for intensifying each other. Black and white, apart from their virtue in stripe and check effects, could be used with advantage to separate colours that partook of a large share of the same common element. In experimenting with related colours it would usually be found that when the need arose for having them contiguous, the most satisfactory effects were obtained when a shade was used in contrast with a tint. Graded colours, either in the form of a colour passing from light to dark or one colour grading into another, formed a useful basis for experiment in the hands of a cloth constructor endowed with artistic taste. It was well to bear in mind that shades formed reliable grounds and that a judicious use of brighter colours in blend and contrast would serve to smarten up the cloth. Where check effects were required they might be, according to requirements, balanced or unbalanced. In work of this kind the strength of the various colours was important; colour balance was essential, and to preserve this the strength of all should be as nearly as possible alike. Bright or expensive fancy yarns should never be used for bulk ground work; these should be used exclusively for embellishing the texture either in the form of stripes or checks. Cloth construction did not end with the weave, with the mathematics relating to the sett, or with the colouring; it must be a practical manufacturing proposition. This was a feature of the cloth constructor's work which required forethought and, in addition, an extensive knowledge of the looms at his disposal. Economic production was only possible when the goods were rapidly and correctly made, and in the making, three factors had to be taken into account, namely, the tenter, the weaver, and the loom. In the construction of woollen and worsted cloths too much stress could not be laid upon satisfactory finish in the development of the handle. Without a suitable raw material even the finisher could not develop the necessary handle. No finisher could repair the damage done to the raw material by excessive use of alkali in wool scouring, by an over-dose of acid in carbonising, or by carelessness in the operation of neutralising after carbonising. Under these circumstances the material took on a harsh, rough, wiry handle impossible to eliminate. No finisher could develop satisfactory goods if the cloth constructor

had made the initial error of setting his fabrics too narrow in the loom. In a case of this kind the finisher was allowed an insufficient margin between the grey width and the finished width. The best advice one could offer in considering the process of milling and its effect upon cloth was that under no circumstances should an attempt be made to force the operation. In conclusion, the lecturer said he was of opinion that the success of the French cloths lay not in the yarn but in the attention paid to mellow finish. Bradford spinners could produce more excellent yarns than the French, but because the French had adopted the old West of England methods—which included a good boiling of the cloths—they had scored. The crown of the cloth constructor's work lay in the hands of the finisher, and a satisfactory finish was summed up in the two words "quality" and "maturity." —M.

Mycological Work in Egypt during the Period 1920-1922*

Two-thirds of this volume deals with diseases of cotton ; the remainder will not be considered here.

Sore Shin—This widely-distributed disease of seedlings is described and a detailed account is given of investigations on the causal organism *Rhizoctonia solani* Kühn. From cotton seedlings suffering from sore shin three fungi were constantly isolated—*Rhizopus nigricans*, *Fusarium* sp., and *Rhizoctonia solani*. Extensive tests showed that only *Rhizoctonia* was parasitic. Infection experiments with plants other than cotton demonstrated that the fungus was able to attack seedlings of castor, sesame, pumpkin, lubia (*Vigna sinensis*), cabbage, lucerne, bamia (*Hibiscus esculentus*), earthnut, water melon, radish, lettuce, carrot, and pea. In addition, natural infections were discovered on seedlings of mustard and cress, and on mature plants of haricot bean, *Colocasia* sp., and bersim (*Trifolium alexandrinum*). The fungus can attack any of the above hosts when transferred from cotton and is also able to attack cotton when passed back from pea, bamia, earthnut, water melon, and mustard. Seedlings of wheat, barley, and maize are not susceptible. The morphological characters of the fungus in culture are detailed, and experiments on its growth relations are described. In culture, sclerotia are formed, and the size of these bodies in a single strain kept at constant temperature is considerably affected by the supply of moisture, food, and oxygen. This fungus is considered identical with specimens of *Rhizoctonia solani* from America and India, and with Ball's sore shin fungus described in 1905. Attempts were made to obtain the perfect stage of the organism, and a small number of spore-bearing basidia were produced when the fungus was growing as a saprophyte. This fertile stage is referred to *Corticium vagum* B. and C., with the reservation that this species contains many forms which may later have to be separated. No variety of cotton resistant to sore shin is known, and the causal fungus is of general occurrence in the soil throughout Egypt. Soil sterilisation for control of the disease is economically impracticable, and no chemical treatment can be generally recommended. Dressing with naphthalene lessens the amount of damage only under certain conditions of soil texture. The chief remedial measures are those which ensure rapid development of the seedling, since the fungus is most favoured by slow germination of the seed in a moist, relatively cool atmosphere. Good cultivation and draining, sowing not earlier than 15th March, and sowing at the right depth and position on the ridge, are therefore the most effective means of combating sore shin. When practicable, a rotation should be employed in which cotton succeeds wheat, maize, or a period of fallow. Cotton planted directly after bersim is specially liable to attack, as bersim is itself susceptible to the disease.

Root Rot—This disease is found in lubia (*Vigna sinensis*), beans, and cotton. The bast of affected plants is attacked and rotted, and sclerotia are formed in the dead tissues. A similar root rot of cotton occurs in India. The causal fungus is described and is named *Rhizoctonia* (*Sclerotium*) *bataticola* (Taub.) Butl. Successful inoculations with this organism were made on lubia and bean.

Angular Leaf Spot—A description is given of this disease (due to *Bacterium malvacearum*), which is not serious in Egypt. The term "anthracnose" is often

*By H. R. Briton-Jones, B.Sc., Ministry of Agriculture, Egypt, Technical and Scientific Service, Bulletin No. 49 (Botanical Section). Government Press, Cairo, 1925.

applied to *Bacterium malvacearum* infections of bolls, but the author has found no trace of true anthracnose (*Glomerella gossypii*) during three seasons in Egypt.

A Wound Parasite of Bolls—*Rhizopus nigricans* is a common wound parasite of bolls. This disease has been described in a separate bulletin.*

Fusarium Wilt—Wilted plants were obtained from Beheira and Sharqiya, showing a browning of the wood and presence of hyphæ in the vessels. From these specimens *Fusarium vasinfectum* was isolated, the cause of wilt disease in the United States. The morphological and cultural characters of this fungus are given. An extensive series of inoculations was made and successful infection was obtained on seedlings and young plants.

Physiological Wilt Disease—In a single locality on salty soil in Beheira Province wilting was brought about owing to protracted flooding of the ground, probably causing asphyxiation of the root systems. —R. W. M.

Rain Cotton in the Sudan†

Before the Manchester Literary and Philosophical Society, on 9th February 1926, a paper was read on the above subject by Mr. R. A. Wardle, M.Sc. Professor F. E. Weiss was in the chair, and the following is an abstract of the lecture—

The Southern Sudan is not an ideal area for cotton grown under rainfall conditions, owing to the shortness of the rainy season and to the uncertain distribution of the annual rainfall, but indigenous short staple cottons have been grown for at least 90 years, and experiments have shown that American long staple varieties can be grown successfully and will produce cotton sufficient in quality and quantity to warrant the establishment of cotton cultivation in the Central and Southern Provinces, thus enabling these areas to obtain a surplus of income over expenditure available for developmental schemes.

The Government policy is—

(*a*) In districts where native cottons have previously been grown, to encourage the cultivation of American long staple varieties by issuing free seed and by providing marketing and ginning facilities;

(*b*) In districts where cotton has not previously been grown, to establish experimental cultivation of American cotton at various centres of demonstration and propaganda, to issue free seed, and to guarantee a price for the crop produced.

Progress within the last two years has been rapid and prospects are very bright, despite the occurrence of problems concerning suitable varieties of cotton, dates of sowing, agricultural methods, interference of cotton with food crops, provision of transport, and ginning facilities, apathy of native tribes, &c. The ultimate limit of acreage under rain cotton will depend largely upon the extent to which road and rail communication between districts and ginneries can be developed.

*Bull. 19, Tech. and Sci. Service, Egyptian Min. of Agriculture.

†Report supplied by the Secretary.

THE JOURNAL OF THE TEXTILE INSTITUTE

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PROCEEDINGS

Lancashire Section

Lantern Lecture and Social Evening held at the Institute, Thursday, 10th December 1925, the late Professor W. Myers presiding.

A MICROSCOPIST'S NOTES ON SOME TEXTILE FIBRES

Mr. Abraham Flatters, whose lecture on the above subject was to have been delivered at this function, was delayed by a railway accident, and was only able to give a synopsis of the lecture, during which a large number of interesting slides* were shown. In the course of his remarks Mr. Flatters dealt with the cotton plant, indicating its botanical classification—it belonged to the Mallow family, of the order *Malvaceæ*—and its geographical range—between 40° north and 30° south. Reference was made to the principal types of the cotton plant which were of commercial value. The protective character of the seed hairs was pointed out, and Mr. Flatters referred to other species of plants which had developed this characteristic. The lecturer then briefly described the reproductive process of the cotton plant, and in doing so exhibited several interesting slides illustrative of the phenomena described, Figs. 1 to 4. The lecturer then discussed the microscopical appearance of cotton hairs in transverse and longitudinal sections, and pointed out the range of variations to be discerned even in the hairs from one seed. He drew attention then to the differences that might be anticipated between cotton from different sources where soil and climatic conditions would vary widely. Turning to other fibres, Mr. Flatters said that it would take too long to describe the development and growth of them all, but that he would indicate the structure of the stem of a typical fibre-yielding plant, and as such he would describe the flax plant. In its early development a zone of growth or cambium ring arises on the inner side of which the wood of the plant is formed; on the outer side the bast fibres develop. The bast fibres are the true flax fibres, and in the economy of the plant their function is that of food conductors. The difference between the fibres seen in the plant before decortication and those from decorticated bundles of fibres was discussed, and attention drawn to the possible agents producing the differences—drying and contraction. Mr. Flatters suggested that the pits in the cell walls, which he pointed out in slides of sections of hemp and of ramie, were food storage devices; this method of food storage being a common feature of the seeds of many plants. The lecturer referred to a practical point in the decortication of

*A selection of these are reproduced here from prints kindly supplied by Mr. Flatters.

bast and leaf fibres, when he said that in their development the fibres of flax, hemp, and ramie are so intimately connected with the cell walls of the ground tissue of the plant that it appears to be practically impossible by any mechanical means to extract them from the stem or leaf without leaving scars on their exterior walls. In fact, if the coarser fibres be examined, it will be found that the original ground tissue still adheres to many of them, and cannot be removed without leaving scars. Turning to plants whose leaves yield fibres, Mr. Flatters instanced the family of *Bromeliaceæ*, the pineapple family, as probably supplying more marketable fibres than any other class, while of this order the two plants furnishing the finest and most easily separable fibre masses are known by the trade names of Arghan and Colombian Pita. The ultimate fibres from either of these plants when compared microscopically appear identical, and there can be no doubt that they are closely related if not actually from the same species of *Bromeliaceæ*, though grown under different local names. A series of slides was shown illustrating the points raised by the lecturer, and of these Figs. 5 to 10 constitute a selection.

Mr. Flatters next dealt with artificial silk, exhibiting slides of the four primary types, and said that he was indebted to Mr. W. Marshall, F.I.C., for information regarding the chemical composition of these types. He then described the four filaments illustrated, in the order of their introduction into commerce. In dealing next with animal fibres, the lecturer said that natural silk must take the premier position. Silk is the product of the silk moth, from the egg of which the actual spinner of the filament, the silkworm, emerges. It is a voracious feeder, becoming fully developed very rapidly, and at this stage spins for itself a protecting cocoon, from which, after passing through various stages of metamorphosis, the silk moth emerges. The silk fibre is a composite one, formed of two separate silk threads, held together by means of a gum-like fluid emitted by the silkworm at the same time as the true silk fibre. The silk is formed in glands occupying a considerable portion of the body of the adult larvæ. It is a viscous fluid ejected from the spinnerets in two distinct jets, the two filaments thus formed being at the moment of emergence coated over with the gummy fluid above referred to. On exposure to the atmosphere the silk hardens. Figs. 11 and 12 are reproductions of two of the slides exhibited by Mr. Flatters at this stage. Turning finally to hairs and wools, the lecturer pointed out that hairs are never entirely absent from the bodies of mammals. Two kinds of hairs might be distinguished, according to the strength and rigidity of the shaft, viz., contour hairs and woolly. Woolly hairs are delicate and curled, and surround to a greater or lesser extent the base of each contour hair. When contour hairs have a greater strength they become bristles, and when still stronger and thicker they constitute spines like those of the hedgehog or porcupine. The colour of animal hairs, the lecturer pointed out, is due chiefly to pigmentations in the hair walls or to a core of coloured fat permeating the fibre cavity, as for example, in the hairs of the llama or of the Cashmere goat.

The late Professor Myers, who presided over this meeting, expressed the thanks of all present to Mr. Flatters for his interesting lecture and for the valuable series of slides he had exhibited.

Luncheon-hour Meeting at the Institute, 26th February 1926, Mr. John Crompton presiding.

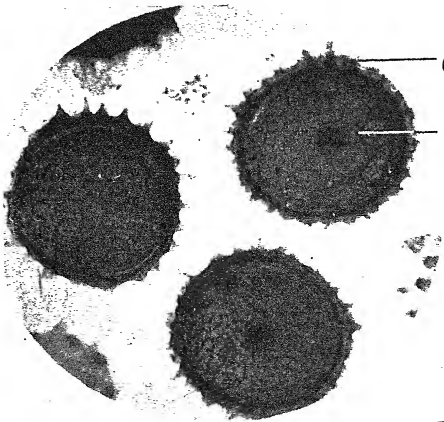
EMPLOYERS AND THE HOUSING PROBLEM

By Reginald Bruce, A.R.I.B.A.

When your Secretary asked me to contribute a paper on the subject for discussion to-day he very kindly sent me a copy of your *Journal* containing a lecture given a short time ago by the manager of one of the large mills. In reading this lecture it was very interesting to find that there are some who realise

Fig. 1.

Photomicrograph of three pollen grains from the ripe anther of the cotton plant, × 260. (*a*) The spiniferous wall, or *exine*, (*b*) the *intine* or male fertilising media.



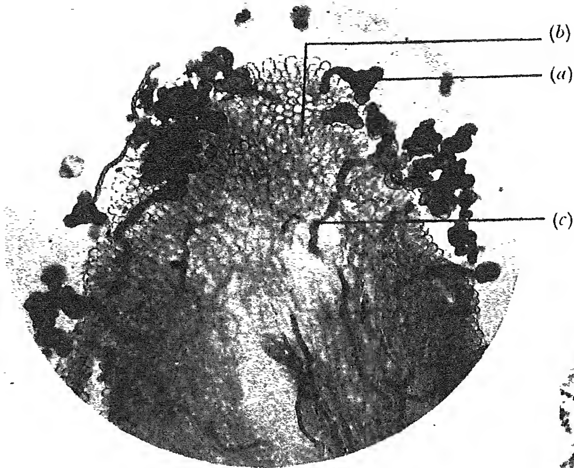
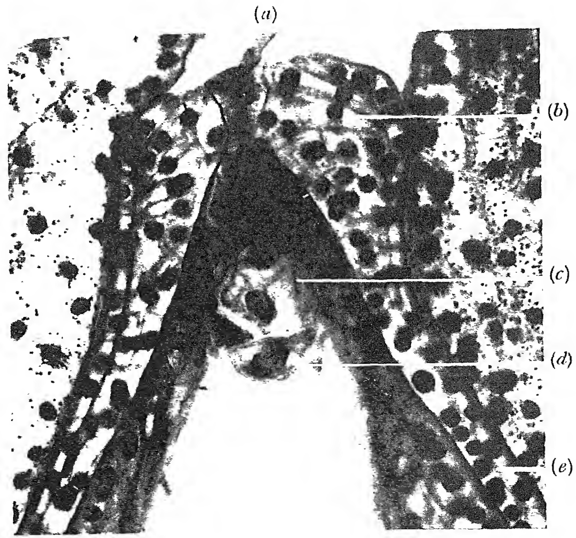


Fig. 2.

Photomicrograph of a longitudinal section through the stigmatic tissue of the Evening-primrose, × 35. (*a*) Pollen grains viewed from various points, (*b*) the stigmatic tissue, (*c*) fragments of pollen-tubes penetrating the stigmatic tissue on their way to the embryo-sac, or ovary.

Fig. 3.

Photomicrograph of a longitudinal median section through the embryo-sac of a Lily, *Lilium martagon*, × 260. (*a*) The pollen tube entering the *micropyle*, (*b*) integuments of the ovum, (*c*) male and female egg-cells, from the fusion of which the new seed is built up, (*d*) the basal cell undergoing division, (*e*) embryo-sac in which the new seed is built up.



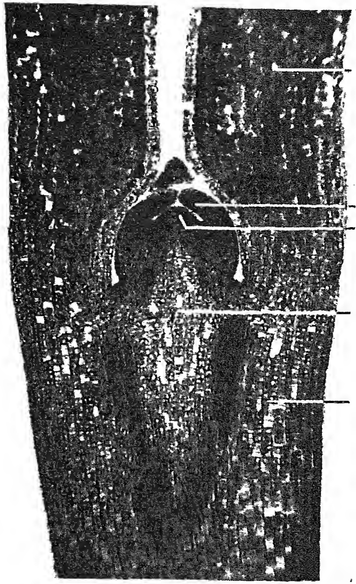


Fig. 4.

Photomicrograph of a longitudinal median section of a seed of the Flax plant, *Linum usitatissimum*, after germinating on damp flannel for 24 hours, ×25. (*a*) The two cotyledons, (*b*) the first pair of foliar leaves, (*c*) growing point of initial stem, (*d*) primary axial area, (*e*) tissue undergoing differentiation, and the formation of the young flax fibre.

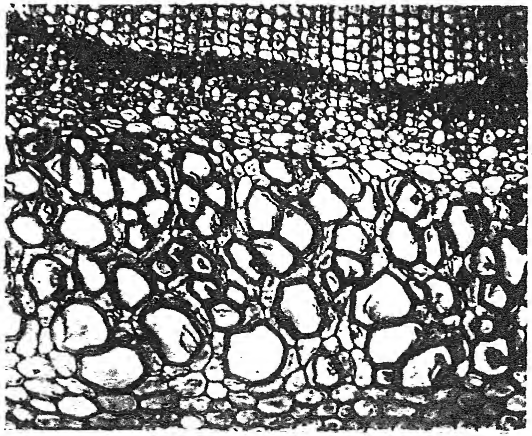


Fig. 5.

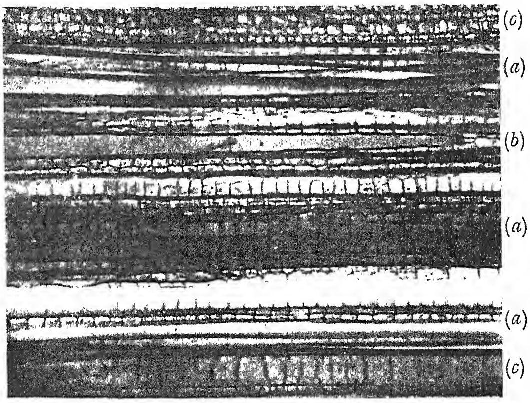
Photomicrograph of a transverse section of the young stem of the common Nettle, *Urtica doica*, ×60. (*a*) Cortical, or primary-ground tissue, (*b*) cambium tissue, (*c*) developing fibres, (*d*) broad band of fibres in advanced stage, (*e*) the inner primary ground tissue.

Fig. 6.

Photomicrograph of a transverse section of decorticated fibre of common Nettle, *Urtica doica*, photographed under polarised light, ×260. (*a*) Inner cambiform tissue, (*b*) various stages in the development of fibres, some of which show pitted walls typical of the Ramie fibre, (*c*) inner primary ground tissue.

Fig. 7.

Photomicrograph of a longitudinal tangential section of the stem of the common Nettle, *Urtica doica*, $\times 40$, passing through the inner part of the bundle. (*a*) Bast fibres, (*b*) bast fibre showing the fibre-ending and connected with the cells of the ground tissue, (*c*) bands of the primary ground tissue.



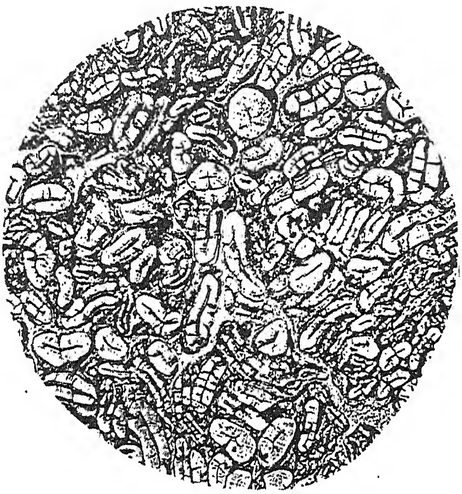


Fig. 8.

Photomicrograph of a transverse section through a staple taken from a Ramie hank, $\times 260$, and showing the pitting, or food cells, of the cell walls.

Fig. 9.

Photomicrograph of transverse sections through decorticated fibre masses of the New Zealand Flax, *Phormium tenax*, $\times 60$. (*a*) Cambium and Xylem elements, (*b*) the bast mass. Some of the masses have portions of the primary ground tissue still adhering.

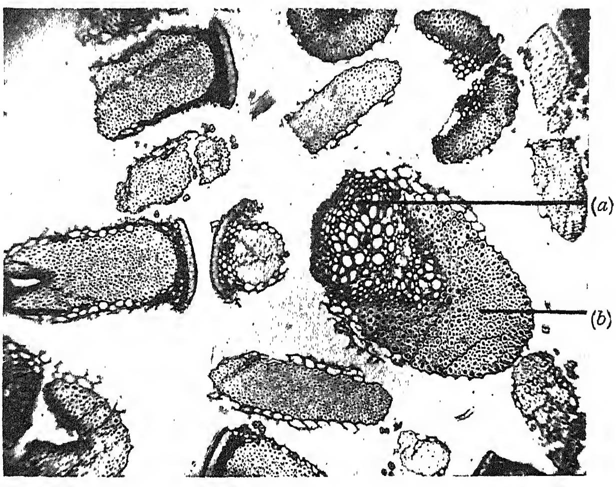
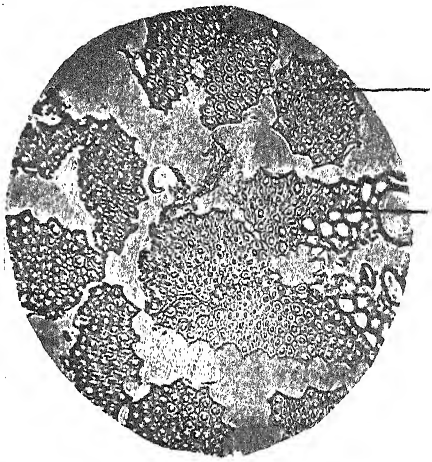


Fig. 10.

Photomicrograph of a transverse section through decorticated fibre masses of leaf of Arghan, ×260. (*a*) Fibre-mass, (*b*) vascular tissue still adhering to fibre-mass.



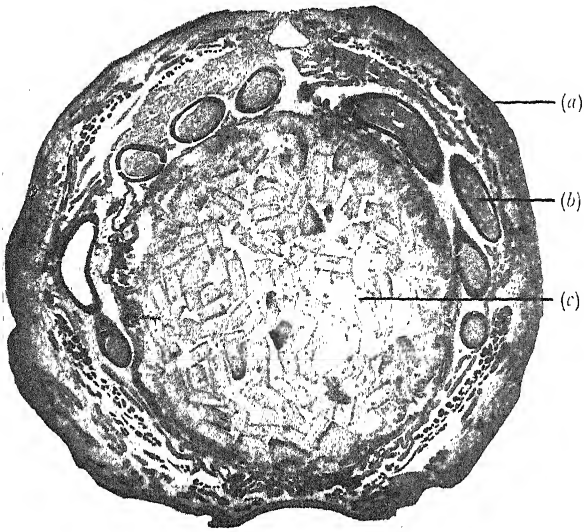
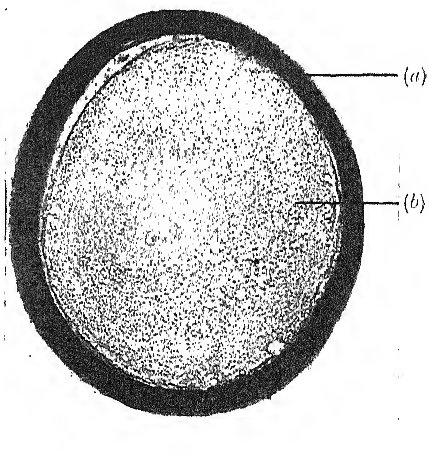


Fig. 11.

Photomicrograph of a transverse section through the body of the silk-worm, × 10. (*a*) Body wall, (*b*) silk glands, (*c*) stomach containing undigested food (leaf parts).

Fig. 12.

Photomicrograph of a transverse section through a silk-gland, ×25. (*a*) Muscular wall of gland, (*b*) silk *in situ*.



that real progress in industry depends upon, and is directly related to, other branches of human activity. Mention was made of agriculture or food production and housing; there are also other important matters, such as transport facilities, public health, and so on. To-day, however, we are to consider only one of these, that of housing. It is not intended to deal with the national housing problem as it is generally understood—a matter which has passed through many vicissitudes, and is likely to continue to be a vexed question. Neither is it intended to refer to what has been done to provide houses for the working classes or the number of houses required to meet the shortage. It is sufficient for our purpose to accept the fact that there is a real need for many more houses to be built, not only to meet the demand of those who are unable to find houses to live in, and in consequence of which there is much overcrowding, but also to replace the thousands of dwellings which, although occupied, are totally unfit to live in. It is not, of course, suggested that employers can themselves entirely solve this problem, nor that it is expected they should. It is, however, suggested that it is in their interests to take an active part in the provision of houses for their employees.

Let us look at the matter from the following aspects—(1) The present position and the need for a broader outlook. (2) Its relation to health and efficiency of the worker. (3) Mobility or distribution of labour. (4) How employers can help to solve the problem.

It is only necessary to look back a few years to realise how greatly conditions of living generally have changed. Not long ago towns were not so large as they are to-day—people did not travel about to any extent, and they had a more leisurely existence—business was very largely centralised, and altogether there was much more independence of action. In recent times the whole method of living has been revolutionised. This is probably very largely due to the introduction of the mechanically-propelled vehicle and the intensification of mechanical appliances in the production of commodities of life and the carrying on of other undertakings. People are now enabled to move about much more than previously, and could, if other circumstances permitted, live farther from their work; goods can be produced more quickly, and their transport and delivery has been expedited and facilitated, and generally a saving of time and money effected. Furthermore, by the development of the telephone service and the introduction of wireless, the execution of business has been speeded up to an extraordinary degree, and towns and countries have been brought into closer contact. Although this has resulted in a broader outlook on life, there would appear to be in some respects a tendency towards isolation of interests—for one activity to assume an attitude of independence, and by so doing to lose sight of its relative position in regard to others and to the integral place it, in fact, occupies in the general sphere of activities of the country. The question therefor appears to be, can we afford to live in such a state of isolation, and can employers of labour afford to take no action or constructive interest in those matters which, although a casual thought might dismiss them as being foreign to the employers' individual concerns, are vitally related to them and essential to their own prosperity. Housing is one of such matters, and one which should occupy an important place in the employers' business purview.

The labour problem to-day is not only one dealing with such matters as hours of work and rates of wages; there are other things equally fundamental, and which must have due consideration in any endeavour to solve the difficulties contingent upon industrial expansion and the development of other activities. Modern conditions are continually raising the standard of living of the workers, and in the march of progress this must be fully recognised and appreciated. No longer is the worker content to work and live under the same conditions which existed a few years ago. He requires better houses to live in, gardens in which to grow food and flowers, open spaces and playing fields where he can

obtain bodily exercise, and the provision of facilities for mental recreation. He demands an entirely different environment to that which was provided for him during the great industrial period of a century ago, and, indeed, to which he is often subjected now. Environment is undoubtedly one of the fundamental attributes in the economical relationship between labour and production. It can without contradiction be said that much of the unrest and discontent amongst the workers during recent years has been largely due to the bad conditions under which they have been compelled to live—the horrible slums and squalid dwellings, the mean streets, and the absence of those amenities which affect the mentality and outlook on life. Is it not a convincing statement to make, that the better the worker is housed, the more pleasant and attractive his surroundings, and the greater the facilities for mental and bodily recreation, the more contented and happier he becomes, and, what is very essential, the more healthy? Is it not equally true that a healthy and contented man is more fitted to perform his daily work, and in consequence must it not materially affect both the quality of the work and the degree of output? This view was undoubtedly in the minds of those responsible for the establishment of some of our Garden Villages, as, for example, Bournville, the founder of which, having removed his works from the centre of Birmingham to a site outside the city, at the same time made provision for the proper housing and social life of his employees, and who subsequently stated that the venture had amply repaid him.

Mobility of labour is also an important factor in any endeavour to solve the problem of housing the workers. Before the war circumstances were such that there was no serious difficulty in transferring labour from one district to another as particular needs arose. It was not a serious matter for a man to remove his family to a district which offered work or where better conditions prevailed, because he was certain of finding housing accommodation. To-day the position is very different, and there have been many instances of work having been held up, and, indeed, business lost, owing to a shortage of labour in the particular locality, notwithstanding the fact that there was much general unemployment. The difficulty has been that amongst the number of unemployed there have been none of the particular skilled workers required, and owing to the shortage of housing accommodation it has not been possible to induce men to transfer from other districts. To do so would mean either a long journey every day from and to their homes, or for the man to go into lodgings and keep his home going elsewhere, neither of which can he afford to do. He would be much better off living on the dole. It is interesting to note that Mr. Churchill, in a recent speech, referred to this important aspect of the subject, and drew attention to the enormous loss that had accrued to labour as a result of this present day immobility. There is also a tendency at the present time for large firms to remove their works into more open country where there is room to expand, or to a situation nearer to the source of supply of some material needed for the production of their particular goods. The question of the housing of the workers, however, does not always seem to occur to them, or if it does it is put aside as being of no direct concern of theirs, but a matter for the speculative builder or the Government and the Municipality. Some help may certainly come in this way, but neither at the present time can be expected to deal adequately with the situation. I venture to say that the employer, if he is seeking to produce the best article and in the most economical manner, and if he would desire to hold his own in the increasing competition in the markets of the world, must realise that industry is only one component part in the economic organism of life, and that the housing of the employees is one of the matters which must have his due consideration.

What, then, can employers do to meet the housing needs—not with a view to solving the national housing problem, which must for some years be left to the country—but in their own interests and from the point of view of economic

living conditions of their employees? Of course the question of finance is always a troublesome one, but surely business men controlling large financial undertakings can find a way out, although in the matter of housing a large return in money cannot be looked for. The question as to whether it is a general advantage for workers to own their own houses or rent them is an interesting one, and in financing a scheme this aspect must be considered. Whilst there is perhaps much to be said in favour of the former, there are very few workers who possess sufficient means to buy houses, or are themselves able to raise the necessary money. Much can, however, be done by co-operative action amongst the employees themselves if properly directed or between the employers and the employees. Where the latter is done it cannot but help to bring about a better understanding, create an attitude of *esprit de corps*, and lead to greater contentment and general efficiency all round.

Now let us consider briefly a few of the methods by which employers can actively assist—

(1) Employers to undertake the whole of the work—acquire the land, have the plans prepared, lay out the streets, and, having erected the houses, sell or let them to their employees. The whole of the financial liabilities in this case to be met by the firms. With the high prices of building, however, and the difficulty of getting an economical return from letting, such a scheme is not likely to be readily accepted.

(2) To undertake the work in a similar way to the above, but obtain the financial assistance by means of subsidies and loans from the Government and the local authorities. A subsidy can be obtained from the Government under certain conditions, the amount depending upon whether it is intended to sell the houses or let them, such subsidy being in the form of a lump sum or an annual payment for a period of years. In addition to the subsidy given by the Government, the Local Authority may add a contribution from local funds if they are in a position to do so. Very considerable loans may also be obtained by bodies erecting houses through the local authorities, such loans being secured by mortgage on the property, and in the case of sale can be transferable to the purchaser if required.

(3) Co-operative action. The method of providing houses by co-operative action between the employer and employee is a very interesting and valuable one. It brings the two elements into close contact, and gives each a personal interest in the undertaking. The success of such a scheme depends upon the true spirit of co-operation amongst all concerned. The formation of what are called Public Utility Societies is quite a simple matter; a number have been established in the country, and have generally proved a great success.

An employer with his employees, or several firms joining together, or any other body, may form such a society, and take advantage of the facilities offered in the way of subsidies and loans under the Housing Acts. A Public Utility Society is one that is registered under the Industrial and Provident Societies Acts, and whose chief object is to provide houses, primarily for letting, but there is no hindrance to selling. Such a society is controlled by a committee of management, who decide upon a set of rules as to how the society is to be organised, and in the case we are considering would have representatives of the employers and also of those employees who desire to become tenants. Unlike a Building Society, whose function it is to loan money to enable people to purchase houses, a Public Utility Society is formed for the purpose of building houses. A society is limited in liability, and there is one important point, which is this, it may not pay a dividend higher than the rate fixed from time to time by the Treasury. Any surplus profits are expended on the improvement of the estate and for the benefit of the society's tenants. The capital required is raised by the issue of ordinary shares, loan stock, debentures, and loans. The tenants would also invest a small sum, and hold say at least one share in the society.

The underlying principle of such a scheme is to assist the employees to provide themselves with houses by joint effort, and as everything is done to their mutual advantage, it is in the interests of all to see that the scheme is carried forward on sound lines. It is important that the site should be well chosen from all points of view, and that the lay-out or planning of the site with roads, drains &c., and the designing of the houses, should be on sound economical lines. If the scheme is large enough, a hall for meetings could be erected, and provision should in all cases be made for recreation.

In conclusion, let me briefly refer to two or three instances where large employers of labour are making provision for housing in connection with their undertakings. An example of the employers themselves carrying out a scheme of housing is of a well-known firm who, unable to expand its works owing to all the surrounding land being built upon, has recently removed to a situation about three miles from the town where transport and other facilities are favourable, and are developing a large village for its employees. The firm has acquired the site, provided ample playing fields and recreation grounds, made provision for schools &c., and has already built 350 houses; many more are to be built. Private loans have been raised, and advantage taken of the Government subsidy. The firm is selling the houses to their employees, and, from a money point of view, at a considerable loss to the firm. The creation of such a village as this is surely a step in the right direction, and such a progressive firm cannot but realise that it is an undertaking which will result in an enormous benefit to themselves as well as to their employees.

Another example is of a firm who erected its works outside the town and provided for the housing of its employees on a site about a mile farther out. The head of the firm established a village Trust, the capital with which it was founded being a free gift. Under the terms of the trust deed all income derived from the village must be devoted to the improvement and extension of the village. The houses are let, not sold, and the income derived from the rents is spent on maintenance, provision of amenities, and the building of additional houses.

The last example to be quoted is that of one of the large railway companies. About three years ago this company, realising that the distribution of labour is with them a somewhat peculiar one, announced a progressive housing policy. The scheme is being worked through Public Utility Societies formed in a number of centres, the respective Committees undertaking the management and reporting to the company the number of houses required. The scheme is financed jointly by the company and the railwaymen, together with the assistance of the Government in the way of subsidies. The company acquire the sites and arrange for the plans to be prepared, and agrees to construct the necessary roads and sewers, and to lease to each society a developed site at a ground rent calculated at 4% upon the apportioned capital outlay. The company also undertakes to advance 90% of the capital expenditure upon the houses, the loans being repayable within a period of 50 years at interest of 4%.

These examples are referred to just to show that some employers are realising what is in fact their responsibility. In such a short time at our disposal it has not been possible to go into details or do more than just indicate how directly and fundamentally the matter of housing is linked up with industry, and to suggest some ways in which employers can deal with it.

Discussion

The Chairman, in calling upon Mr. Bruce to read the foregoing paper, said that it came at the close of a series of lectures dealing with the relations between the masters and the operatives and the training and general conditions of employment of the latter. All were very desirous that the conditions of labour in textile factories should be as perfect as possible. They were also, however, concerned with the conditions obtaining outside the factory. While it was true that the employer had not got money to spare to build houses for his

workpeople, yet he was quite willing to serve in any other way he possibly could. From this point of view he thought it was wise that they should have an address from Mr. Bruce, whose lecture he was sure would prove very helpful and suggestive in the matter of the solution not only of immediate problems but of those of the future.

Following the reading of the paper, the Chairman said that Mr. Bruce would perhaps excuse them if they regarded the matter from the point of view that their works were already established. The majority of employers in the textile industry were anxious to establish the very best possible housing and working conditions for their operatives. Personally, he felt that it was their duty to do so. He had had some experience in the provision of housing accommodation, and he would advise employers to be very chary as to action in that direction. It was bad enough nowadays to cope with the difficulties of management in the works, but if there was any appearance that certain individuals or sections were being favoured by having better houses, or more attention in their houses than others, the problems of management would be much more complicated, and jealousy would be introduced. Employers experienced enough difficulties in finding out the best operatives and guiding them right, from their entrance into the works from the schools, and in finding out what they were best adapted for, without troubling too much about the conditions outside. Of course many employers in the textile industry were vitally interested in the educational problem, which he thought should be managed principally by outsiders. He had the pleasure of drawing the attention of the Institute to the advisability of continued education between the ages of 14 and 16 by allowing young people to attend technical classes or continuation classes each third week, or one-third of their time. It was, however, not of much avail for one firm to do it; if it was beneficial for one it was beneficial for all. The Lancashire County Council would willingly co-operate with manufacturers in promoting such schemes. The financial side of the housing problem was very serious. There were, of course, plenty of instances in foreign countries where employers had built houses for their workpeople. In the United States, some fifty years ago, a person could not put up a works without having to provide housing accommodation as well. Unfortunately, such accommodation usually took the form of barrack-like structures. Anyone who went to Fall River now would see almost worse slums there in connection with these barrack structures than they would in certain parts of Lancashire. It was important that there should be no discouragement of active co-operation between the employer and the employee, and it was distinctly advisable that the employee should be able to purchase his own house. This practice obtained very largely before the war at Great Harwood and other Lancashire districts. Formerly workpeople could buy their houses for about £150, but now they would have to pay £500 or £600 for a similar type of house.

Col. F. R. McConnel mentioned that he had had the management of at least two concerns which had to provide housing accommodation for their workpeople. The problem of providing houses of the highest possible comfort and efficiency was an exceedingly interesting one. Both the cases he referred to were in country districts, where they had not to deal with the trouble and expense of providing street paving, large sewers &c. As far as making such provision in country districts was concerned, he was a great believer in simplicity. A plentiful supply of good fresh water was necessary, and if there was ample room and air space an immense amount of money could be saved without detriment to the health of the people. Modified methods of main drainage could be adopted. It was desirable, in certain trades, to have the houses not only economically built but capable of being removed. He had rather a feeling that the best way to deal with a textile village would be to burn the whole lot down in about 20 years and start again on fresh ground. It would be very much more healthy, but it could not always be managed. To elaborate rules and conditions with

regard to the building of "permanent" houses was a mistake. Some mills had been built for all time—fireproof material, and all the rest of it. Perhaps they had already been up for 50 years, and would last for another 50 or 100 years, possibly to the horror and disgust of their owners, because they could not use them properly. The same consideration applied to dwelling-houses; they should not be too permanent. They should be inspected to see that they were kept in sanitary condition, and then there should be plenty of fresh houses so that anything approaching a slum could be demolished. Housing was at least as important as education. It was the duty of employers to press forward the supply of fresh, comfortable houses for the working classes, and, moreover, it would prove to be a remunerative investment from many points of view.

Mr. T. Fletcher Robinson inquired whether in regard to utility societies it was possible to obtain loans at a lower rate of interest than those from the Government, apart from subsidies. If so, it would help the Government considerably.

Mr. Bruce said that was the case.

Mr. E. N. Whittaker asked what was the type of model house Mr. Bruce would recommend ?

Mr. Bruce said it was rather a difficult question to answer. It must be a type of house which would meet the needs of the people, and it was not possible to give a broad general outline of what was needed by them. What was required in one district did not apply to another. Generally speaking, a house should have a very large living-room, and if the people wished to have a parlour they should have it by all means. There should also be a very ample kitchen and three bedrooms. A society such as he had described generally understood the needs of those for whom it was catering. The tenants were becoming the owners of the property, and if certain of those tenants wanted two bedrooms only, because of having no children, that could be arranged. In his opinion, the working part of the house was the most important.

Mr. W. P. Crankshaw said he had lately had the privilege of inspecting a large new artificial silk factory erected in an entirely non-textile district. Railway and chara-a-banc transport arrangements had now been instituted by which the company were enabled to draw upon the available female labour of the county.

Mr. Bruce, in reply, said that transport was a matter which industry must always consider in relation to progress. Many mills were placed in such situations that it would not be possible to house the workpeople within a distance of two or three miles. Railway companies now gave a great deal of consideration to such positions. There was a tremendous waste of time and money due to congestion in big town centres. For instance, coming from Burnley to Liverpool by road a great deal of traffic came through Manchester on the Liverpool Road *via* Warrington. Hours of time were wasted in the central parts of Manchester owing to traffic congestion, and the non-provision of by-pass and skirting roads. Employers must take a greater interest in such matters, and force local authorities to make adequate provision for through traffic.

Mr. W. Bailey, in moving that the best thanks of the meeting be accorded to Mr. Bruce for his excellent paper, and also to Mr. Crompton for presiding, said it was remarkable that the people who lived in the slums of such places as Belfast and Glasgow were not really worse than they were.

Mr. T. Fletcher Robinson seconded the motion. The housing question was one in which the textile industry was deeply interested. Money was very difficult to raise, but, after all, a great deal could be done by those who had a deep interest in the work. Much might be done by the scheme of Committees mentioned by Mr. Bruce, while there were, in addition, Government loans and subsidies to be considered. In order to ensure the mobility of labour it was not too much to ask that the employer should build houses to be let at reasonable rentals. People were having to travel from such places as Bolton to, say, Oldham, to follow

their employment, with the result that much expense was incurred. He then put the vote of thanks, which was carried with acclamation.

Mr. Bruce, in responding to the vote, referred to the question of the mobility of labour. Unfortunately, local authorities in devising housing schemes were not accustomed to consult with employers as to where houses should be erected, so that accommodation was not always provided in the best position from the worker's point of view. The worker always desired to be as near his employment as possible, all other conditions being favourable. It was for this reason that he urged leaders of industry specially to interest themselves in the matter. With regard to jealousy existing among the workers, if a firm undertook to do the work in the manner outlined in the paper, the whole plan would be dealt with co-operatively. The workers would be concerned personally, because they would be the tenants and/or the owners of the houses if they were members of the society. If they were not, they would be out of the scheme and have no concern with it; so that there would be no question of jealousy or favouritism as between the employer and the employees. There was a great deal of force in the argument that houses should not be built to last for an unduly extended period of years.

TEXTILE SOCIETIES AND KINDRED ORGANISATIONS

VISIT OF DELEGATES TO BRADFORD TECHNICAL COLLEGE

On Saturday, 24th February, in place of the usual conference of representatives of Textile Societies and Kindred Organisations held at least annually, a visit took place to the Textile Department of the Bradford Technical College, when a company of about fifty attended, representing various textile societies in Yorkshire, Lancashire, and the Midlands, and also mill managers' associations and the Federation of Managers' Associations. These gatherings were promoted a few years ago by the Textile Institute, which has continued to provide the secretarial services in connection therewith. The Bradford Textile Society offered a cordial welcome to delegates to visit Bradford, and the Principal of the Technical College extended an invitation for inspection of the textile department at that institution. The delegates were met at the College by the President of the Bradford Textile Society, Mr. Sydney E. Illingworth, who extended to them a hearty welcome. He said he was glad to witness so representative a gathering of delegates. Bradford was always pleased to welcome those who were connected with the textile industry of this country or of the Empire. In Bradford a great deal of time was spent in bringing out new cloths, and he hoped the delegates would not go away without leaving some record of their opinions as to what was taking place in the College with a view to helping the industry.

Principal H. Richardson also welcomed the delegates, and said their relationships with the Bradford Textile Society were exceptionally close, and on that account they regarded it as a great privilege to entertain guests from other societies on an occasion of this description. In that department of the College they were mainly concerned with the instruction of young people who had to earn their living at the same time that they got their training. It was only by the linking up of the various organisations that the best service to the industry could be rendered. Progress was also dependent on the general support and goodwill of those directly concerned with the industry; at the College they would welcome constructive criticism.

Professor E. Midgley, head of the Textile Department, explained the course of inspection decided upon, and the delegates then viewed the various sections of the department in suitable groups. Subsequently the delegates were entertained to tea by the Bradford Textile Society, when Mr. Illingworth presided.

The minutes of the previous meeting (17th October 1925) were approved, and it was agreed that the next conference should take place in October next, the details being referred to a small sub-committee comprising Messrs. John Robinson (Textile Institute), Henry Binns (Bradford Textile Society), and the General Secretary of the Textile Institute (J. D. Athey). After tea, Mr. J. H. Dawson (Brierfield), representing the National Federation of Managers' Associations, referred to the inspection of the College, and said he had come to the conclusion that with respect to machinery equipment the position at Bradford was relatively highly advanced. Even in regard to high drafting, about which so much was heard in Lancashire at the present time, it seemed to him that in certain machines installed in that College they had already got quite definite introduction of the principles connected with high drafting. As delegates, they had been invited to offer constructive criticism, but he was afraid that such criticism could better come from Yorkshire to Lancashire rather than from Lancashire to Yorkshire. He was forcibly struck with the accommodation for instruction as to raw materials. He understood that there were seven class-rooms, and that a full course was offered in regard to raw materials. It would not be a bad thing if something of the same kind were in operation in the cotton industry area. The only possible suggestion he might possibly offer would be that the cinema might be introduced in a department like that which they had inspected, and slow motion films provided for the purpose of instruction in machinery motions.

At this stage of the proceedings, Mr. Ernest A. Herbert, Chairman of the Executive Committee of the Bradford Textile Society, took the chair, as Mr. Illingworth was obliged to leave. He said that meetings of this description were exceedingly helpful, and Lancashire and Yorkshire representatives should get more together than they did.

Mr. John Chamberlain (Leicester Textile Society) then spoke, and said that so far as his own district was concerned their chief difficulty was to get day-time students, and the various textile societies should be interested in the complete problem of technical instruction.

Councillor B. Walton (Todmorden Textile Society) also spoke, and said the College was certainly exceedingly well equipped with machinery. With regard to technical instruction generally, the teaching profession was mobile, but the machinery was not, and this meant that students in many of our smaller districts were labouring under a very big handicap, inasmuch as they had to pass the same examinations as those students who secured the advantages of the better equipped institutions. He did not know whether anything more could be done in regard to travel facilities for students to attend the more completely equipped colleges.

Mr. E. C. Parker (Nelson), representing Burnley and District Managers' Association, said he was convinced that a meeting of this description enlarged their field of conception, and it was only by co-operation and interchange of views and ideas that the industry as a whole could be assisted. Exchange of information from one branch of the industry to another must be beneficial.

On the motion of Mr. John T. Stokes (Leicester Textile Society), seconded by Mr. G. W. Haigh (Halifax Textile Society), a hearty vote of thanks was accorded to the Bradford Textile Society and to the College officials and staff for their hospitality and grant of facilities, Mr. Herbert, Professor E. Midgley, and Mr. J. Dumville responding.

London Section

Discussion Meeting at the Institute's Rooms, 38 Bloomsbury Square, W.C.1, 1st February 1926. Chairman, Mr. T. Bray.

THE PRODUCTION OF DESIGN IN FABRICS

Mr. E. B. Fry, who opened the discussion, stated that he intended to discuss the production of design in fabrics, and for that purpose to show a series of lantern slides, explaining each in turn. He suggested that "pattern" would have been a more correct description than "design" in the title of his paper, as he intended to deal with the subject more from the constructional point of view than from the art or design standpoint. He hoped to show how the production of pattern affected the economical manufacture of fabrics. He proceeded to deal with elementary principles underlying all types of weaving, illustrating each point with lantern slides. He first described the earliest and most primitive types of weaving, going from thence to the more elaborate hand looms, the simpler power looms, and so through the whole range of tappet, dobby, and jacquard looms, pointing out that each progressive stage marked the control of an increasing number of threads, so making possible the production of more and more elaborate designs. Simple weaves, such as plain twill, diagonal, sateen, repp, crêpe, &c., were shown, and the various arrangements of threads for the production of suitable designs were demonstrated. The question of the relative speeds of various types of looms and the relative proportions of warp and weft were discussed from a point of view of economical production. The use of fancy yarns, such as grandrelle, gimp, loops, and slub yarns, were demonstrated by means of photographs of fabrics. Various methods of printing, both on the warp and on the completed fabric, were shown, and the various methods of introducing design by dyeing, cross dyeing, and combined printing and dyeing were explained. The lecturer also dealt with imitation and real embroidery, showing how closely the loom could copy the embroidery machine. He also explained the characteristics of construction of double and multiple cloths, illustrating each example with weave diagrams and photographs of the fabrics, including backed cloths with two-colour effects, mantle cloths, quiltings, hose pipes, pillow slips, canvas bags, &c.

In the discussion which followed the lecture, the question was raised as to whether the embroidery in many of the beautiful Indian shawls was not really the product of the embroidery machine. Mr. Howard stated that in many years' experience of this type of fabric, he had to confess that it was sometimes impossible to tell whether a shawl were hand embroidered or not.

In answer to a question, Mr. Fry explained how crêpe effects are produced, by weaving with a heavily dressed hard twisted yarn, and subsequently removing the dressing in the finishing process, thus allowing the yarn to crinkle up.

Mr. Bray, in moving a vote of thanks to the lecturer, stated that he had never had the pleasure of witnessing so fine a collection of lantern slides on this subject, and he must heartily congratulate Mr. Fry on the excellence of his illustrations.

Mr. Fry, in reply, stated that he was a great believer in the use of lantern slides for papers of this type, and he hoped that in the future more use would be made of the projecting lantern by the London Section.

(The projection lantern was given by Mr. Fry to the London Section in February 1924. This meeting was the first occasion on which it had been used.)

NOTES AND NOTICES

Meeting of Institute Council

At the last meeting of the Council of the Institute, on Wednesday, 17th March, the attendance was unusually small owing to a variety of exceptional circumstances. Mr. John Crompton (Chairman) was abroad, Mr. W. Frost (Hon. Secretary) was in London, partly on account of Institute business, whilst Mr. John F. White (Bradford) was unable to be present owing to indisposition. Mr. Oscar S. Hall, who attended after a rather prolonged period of absence from Council meetings, was voted to the chair as the senior member present. The business was considerable, but the proceedings were not protracted. The Secretary presented a list of nominations received in connection with the Annual Election of Council and Vice-presidents. In the latter connection, Messrs. John Crompton and H. P. Greg were nominated by the Council, and as there was no additional nomination the Council added the name of Mr. J. H. Lester. There are three vice-presidential vacancies and three nominations, so that there will be no ballot as to Vice-presidents. In the case of the Council itself, however, for the ten vacant seats twenty nominations were returned, so that an election by ballot will take place and ballot papers will be issued in due course and in due time for return prior to the Annual General Meeting on the 21st April. The Secretary also reported that for the presidency the invitation of the Council to Mr. William Howarth, of the Fine Cotton Spinners' Association, had been accepted and a letter from Mr. Howarth was appreciatively received.

Institute Diplomas: Fellowships and Associateships

The Council had before it, at the same meeting, a further instalment of recommendations of the Selection (Diplomas) Committee for admission of applicants to the Fellowship and Associateship of the Institute, and the list was approved without exception. This was the third instalment, making a total of 105 awards—74 Fellowships and 31 Associateships. The names will be announced at the Annual General Meeting, 21st April, and in the case of Mr. J. H. Lester, who is to receive the second Certificate of Fellowship—the first having already been awarded to the existing President (Mr. John Emsley, J.P.)—a special presentation of the certificate will be made at the meeting. It may be here mentioned that the total number of applications for Diplomas at the time of the writing of this paragraph has reached 190, and the work of the Selection Committee, as may be readily imagined, has been most formidable. The Committee meets with great frequency and all applications are fully considered, whilst decisions arrived at are presented for confirmation at a subsequent meeting, before any definite recommendation is sent forward to Council.

Proposed Meeting at Dunfermline

At the time of the Institute's visit to Dunfermline, in connection with the Annual Conference held at Edinburgh last Whit-week, the suggestion was made that during the present session a further meeting might take place at Dunfermline of a more or less local character. Negotiations have been proceeding in the course of the last few weeks, and it was hoped to arrange for a lecture on the subject of electrical driving. A disappointment was experienced in regard to overtures for the contribution of a paper, and ultimately it was decided on a further recommendation from Dunfermline that the meeting should not take place until the very early part of next session. A lecture has been arranged for, however, and definite engagement arranged for delivery at the later date.

The Publications Committee of the Institute

At this month's meeting of the above Committee, a suggestion was made that a very interesting paper on "The Problem of Unemployment," by F. Wigglesworth, might either be published in full or in extended abstract in this *Journal*. It was decided that to publish in full a paper that had already appeared in another journal was contrary to the policy of the Committee and involved, moreover, unnecessary expense. The third instalment of the article not having yet appeared an abstract was not possible, and other arrangements have been made. By the courtesy of the Editor of the *Journal of the Swedish Chamber of Commerce for the United Kingdom*, in the January, February, and March issues of which this article appears, members of this Institute interested in this subject may receive copies of the issues containing the article (as long as the supply lasts) on application to 14 Trinity Square, London, E.C.3.

By a misunderstanding the line indicating that No. 10 and No. 11 of the Transactions of the Institute published in the February issue of this *Journal* emanated from the British Research Association for the Woollen and Worsted Industries was omitted. Apologies have been made to the Association and it is hoped no inconvenience will arise from the omission.

Association of Special Libraries and Information Bureaux

A business meeting, at which it is proposed formally to inaugurate the Association of Special Libraries and Information Bureaux, will be held at the Institution of Mechanical Engineers, Storey's Gate, S.W.1, at 2.30 p.m. on Monday, 29th March 1926. All interested are cordially invited to attend. The Association is being formed to facilitate the co-ordination and systematic use of sources of information in science, industry, commerce, and public affairs generally; when fully developed it will function as a clearing house for those wishing to get into touch with specialised knowledge. The Association's first activity is to be the compilation of a Directory of Special Libraries and Information Bureaux in the British Isles. No complete list exists at present, and the Directory should therefore prove a valuable book of reference; the work will be authoritative and will indicate the sources where both scientific and non-scientific information may be obtained; the entries in the Directory are to be carefully annotated throughout. The whole movement is deeply indebted to the Carnegie United Kingdom Trustees, who in addition to setting aside the sum of £1,500 to assist the Association in the first two years of its work, have now generously undertaken to defray the cost of compiling the Directory. It is anticipated that something like a year will be occupied in collecting the necessary data. Those in touch with special sources of information and willing to collaborate with the Association in building up the Directory are asked to communicate with the Organising Secretary, 38 Bloomsbury Square, W.C.1, from whom further information may be obtained. Two very successful conferences have been held, at Hoddesdon (1924) and at Balliol College, Oxford (1925). The proceedings have been published, and copies can be obtained (price 7s. 6d. for the two reports) from the office of the Association, 38 Bloomsbury Square, London, W.C.1. This Institute is represented on the Committee of the A.S.L.I.B. by Dr. J. C. Withers, Chairman of the Publications Committee.

Institute Membership

At the March meeting of the Council of the Institute, the following applicants for membership were elected—Cyril O. Clark, York House, Belle Vue, Bradford, Yorks. (Textile Chemist and Technologist); Charles F. Foulds, "Overdale," Colne (Cotton Manufacturer); Rufus Gaunt, 60 Bent Lane, Prestwich, Manchester (Research Chemist); Harry Kenyon, 6 Victoria Terrace, Sandy Lane, Leyland (Loom Overlooker); John W. Kenyon, 6 Victoria Terrace, Leyland

(Mill Manager); George H. O'Brien, Lloyds Bank Buildings, King Street, Manchester (Patent Agent); Walter Stokes, Lal-imli Mansions, Cawnpore, India (Manager—Worsted Drawing, Spinning, Twisting, &c.); Katsuzo Tatsuki, 9 Herbert Street, Whitworth Park, Manchester (Teacher of Chemistry); A. Whitehead, 3 South Parade, Manchester (Merchant and Shipper); Brook Crabtree, 79 Honeywell Road, Wandsworth Common, London, S.W.11 (Examiner of Cotton and Linen Textiles); May Gwendoline Douglas, 60 Nimrod Road, Streatham, London, S.W.16 (Silk Instructor); Eirylys Ruth John, 242 Victoria Road, Romford, Essex; Harold J. Stewart, 7 Mallinson Road, Wandsworth Common, London, S.W.11 (Shipping Clerk—Textiles); Samuel A. Williams, Westminster Day Continuation School, 66 Horseferry Road, London, S.W.1; M. A. Whitney, 27 Warwick Lane, London, E.C.4; Charles Barker, 1 Booth Street, Manchester (Director of Greg Bros.); Edward Hall, Messrs. E. Hall & Bro. Ltd., Whaley Bridge (Bleachers); Morris Hastie, 52 Waverley Road, Bradford (Textile Chemist); D. Hill, 34 Longton Grove, Sydenham, London, S.E.26 (Student, School of Economics); F. W. Hoyle, 19 Chenistoun Gardens, Kensington, London, W.8 (Buying Dept. of Clothing Retail Store); A. E. Mellor, Greg Bros. and Co. Ltd., 1 Booth Street, Manchester (Company Director); Khim Moung, College of Technology, Manchester (Assistant Spinning Master); Pei Y. Sheng, Dobson & Barlow, Ltd., Bolton (Textile); Lancelot Stell, 1 Fardene Terrace, Silsden, near Keighley (Efficiency Manager to Messrs. F. Willey & Co. Ltd.).

Publications Added to the Institute Library

January—March 1926

Books

Les Soies Artificielles. Second edition. (Gauthier, Villars & Cie.)
Artificial Silk and its Manufacture. J. Foltzer (Sir Isaac Pitman & Sons, Ltd.).
Report of the British Association for the Advancement of Science 1925.
American Society for Testing Materials. Proceedings of the Twenty-eighth Annual Meeting. Parts I. and II.
Concerning the Bleaching Industry. The Bleachers' Association 1925.
Michigan State Board of Agriculture. Thirty-seventh Annual Report of the Experiment Station 1924.
The Silk and Rayon (Artificial Silk) Directory and Buyers' Guide of Great Britain. (John Heywood, Ltd.)
Linen, Hemp, and Jute Trades Directory 1926. H. R. Carter.
Chemist's Year Book 1926. (Sherratt & Hughes.)
Cotton Year Book 1926. (Marsden & Co.)
Wool Year Book 1926. (Marsden & Co.)
Textile Manufacturer Year Book 1926. (Emmott & Co.)
Incorporated Accountant's Year Book 1926.

Pamphlets

British

"Art and Commerce." Reprint from "The Studio," London.
National Institute of Industrial Psychology—
Annual Report 1925.
Vocational Guidance Report to August 1925.
"Discrimination of Wool Fabrics by the Sense of Touch." H. Binns (Cambridge University Press).
Leeds University. Twenty-first Report 1924–25.
"Business Possibilities for 1926." Sir C. W. Macara.

Colonial

Union of South Africa—
Science Bulletins 38 and 42.
Trade Reports, April to August 1925.
Colony and Protectorate of Kenya. Bulletins 3 and 4.
Australian Association of British Manufacturers. Constitution and Rules.
Agricultural Research Institute, Pusa. Bulletin 163.
Bengal Department of Agriculture—
Annual Report 1923–24.
Final Cotton Crop Report 1925–26.
Punjab Department of Agriculture. Report on the Operations of. 1924.

Trinidad Imperial College of Tropical Agriculture. Prospectus.
Barbados Department of Agriculture. Report 1924–25.
Jamaica Department of Agriculture. Report 1924.

FOREIGN

U.S.A. Department of Commerce. Cotton Production and Distribution 1924–25.
U.S.A. Bureau of Standards—
- Scientific Papers, 515 and 518.
- Technologic Papers, 281 and 298–300.
- Circulars 280, 284, 285, 287-294, and 298.
- Miscellaneous Publications, 66, 69, and 71.

Michigan Agricultural Experiment Station—
- Quarterly Bulletin.
- Technical Bulletins, 69–73.

Dockham's Cotton Merchants' Directory 1925–1926.
Union de Banques Suisse, L'Année 1925.
Ingeniors Vetenskaps Akademien. Handlingar, Nos. 44–46.
Ministry of Agriculture, Egypt. Technical and Scientific Bulletin, 67.

REVIEWS

Bibliography of Bibliographies on Chemistry and Chemical Technology, 1900-1924. By Clarence J. West and D. D. Berolzeimer. Published by the National Research Council, Washington, D.C., as their Bulletin No. 50 (308 p., $2.50).

This work is composed of the following sections—General Bibliographies, Abstract Journals and Year-books, General Indexes of Serials, Bibliographies of Special Subjects, and Personal Bibliographies. As the title indicates, the work is a compilation of bibliographies published either separately or at the end of books or magazine articles, or as footnotes to the same, on the numerous aspects of pure and applied chemistry. Each entry gives name of author or compiler, title, and place of publication. The majority of the entries state the number of references, thus giving an indication of the completeness of the particular bibliography. The entries are classified under the proper subject headings, alphabetically arranged. The duplication of individual entries has been largely avoided by the use of cross-references. Although no claim is made for the completeness of the compilation, it is believed that the work will furnish a convenient starting point for any bibliographic search.

Linen, Hemp, and Jute Trades Directory. H. R. Carter, Belfast (276 pages, 8s. 6d.).

This publication is a comprehensive and useful collection of all the multifarious branches of the above three Industries and Subsidiary Trades connected therewith. The volume is divided into three chief sections—(1) Linen, (2) Hemp, including "Sisal," and (3) Jute—and concludes with a useful list of technical publications on textile subjects.

The linen section has been carefully classified into its correct sequence of industries and separate trades. These include flax seed merchants, agents, and exporters of all the countries of the world, and a few of the chief flax cultivators in the British Isles, the Colonies and Protectorates, and Foreign countries. These are supplemented by a long list of flax scutchers, while the flax and tow merchants of Ireland, England, and Scotland, together with those of the chief European countries, constitute a formidable and final list of all firms interested in the preparation and distribution of the raw material. Next follow fourteen pages in alphabetical order of flax and tow spinners in the British Isles, Europe, and the United States of America. The manufacturers of linen thread are likewise listed. Forty pages are devoted to the classification of linen manufacturers throughout the world. These are grouped and returned under the specific denominations of general linen, damasks, handkerchiefs, dress linens, tablecloths, lint, flax hose pipe, and webbing and tape manufacture. Yarn and cloth bleachers, dryers, and finishers complete the list of those interested in the final product of woven saleable linens. Upwards of fifteen pages are reserved to enumerate the list of linen merchants. This linen section is closed

with lists of machine makers for flax scutching, preparing, and spinning, including hackling, carding, and combing, bobbin makers, and mill furnishers.

The hemp and jute trades are likewise treated. The book has been carefully and well indexed, and should prove of much advantage for reference to all engaged or interested in the above trades. —F.B.

Concerning the Bleaching Industry. Compiled by Sir Alan J. Sykes. Published by Bleachers' Association, Limited.

This is a commemorative volume of a very attractive kind and is to mark the completion of the first quarter of a century's work of Bleachers' Association, Limited. It consists of an historical outline of bleaching practice; an account of the Association's formation and development; a description of the new headquarters of the Association—Blackfriars House; and some valuable particulars of bleachworks past and present. The historical section is most interesting and it is aptly said that "the history of bleaching is the history of civilisation." In this country at any rate it is undoubtedly so. As early as 1322 four bleaching grounds existed at Curmshal (Crumsall), and from that time onwards records exist which clearly indicate how Lancashire by an association of circumstances became the "cotton county of the British Isles," and thus, by necessity, the centre of the bleaching industry. Opposition to the use of cotton, as being inimical to the interests of sheep farmers and woollen merchants, came to a head in 1700, when it was enacted that the use of cotton was forbidden and the bleaching industry also made only such progress as the stern eye of the law allowed. This historical outline could freely be quoted if space permitted, as it is lucidly written and presents matter of great value to those interested in this aspect of industry. Perhaps a cheaper edition of the work could be put on the market, thus becoming available to a much wider public. Reference must be made to the series of "episodes" which are included in this section of the volume, and which deal with such subjects as the early Manchester Chamber of Commerce, selling a secret process, croft breaking and the infliction of the death penalty for so doing, and the Society of Bleachers out of which the present Association arose. Turning to the next section of the book it is worth noting that the portrait reproductions of the Chairman and other officials of the Association are exceptionally good. The account of the functions and activities of the Association in their trade aspect, as well as in regard to their welfare and recreational aspects is a record of which those responsible may be proud. A description of the site of Blackfriars House and its owners, so far as they can be ascertained, introduces the next section of the volume, and a brief account of "the Bleachers' " headquarters does no more than justice to a building that is rightly claimed to be worthy of the "best architectural traditions of Manchester." With the story of some early bleachworks and some illustrations of bleachworks past and present, the volume concludes. The work is noteworthy, too, in respect of the reproductions of various ancient documents, such as the title page of "Smegmatalogia," a book on the art of making potashes and soap and bleaching of linen; the original licence, dated 1815, granted to Slaters, of Dunscar, to manufacture "oxygenated muriatic acid," as chlorine was then known; the original agreement between sundry employees of Thomas Ridgway & Co. to form a building society; and an indenture between two "whitsters" and an apprentice, executed in 1791, being not only well produced but of definite historical value. The binding and general appearance of the volume is excellent, but there is such a liberal use of red borders, initials, and emblems in the first dozen pages that the pleasure afforded by the first page is proportionately diminished as repetition reveals itself. There can be no doubt that this souvenir will be treasured by all recipients.

—H.L.R.

Illustrated Technical Dictionaries: Volume XVI, Weaving and Woven Fabrics. Edited by Alfred Schlomann. Published by Lewenz & Wilkinson, Ltd., Victoria Street, London, S.W.1 (710 pp. including Index in six languages, 41s. net).

This volume with Volumes XIV., Raw Materials, and XV., Spinning, completes, for the time being the textile series of these admirable dictionaries. There can be no question that these books have been urgently wanted for years, and there should be a ready sale for the three volumes. It is announced that a fourth

volume, dealing with Bleaching, Dyeing, Printing, and Finishing, as well as such subjects as Knitting, Hosiery Manufacture, Embroidery, and Sewing Machines, is in course of preparation. It might be suggested to the compilers that a similar service for Laundering and Dry-cleaning would round off the series in a most adequate manner. The highest of praise is due to the compilers for the detailed nature of the work and for the wealth of illustrations. It would reduce the value of the work many times were these latter not provided. The compiler records his thanks for the services of Professor H. Brüggemann, Mr. Oscar Hall, Mr. H. I. Lewenz, and Mr. Scott Taggart for the ungrudging pains they have taken in the exceptionally difficult work connected with these dictionaries. There can be no hesitation in saying that the result of the work of all concerned is a valuable and excellent series of reference works likely to be of great use to the whole industry. —H.L.R.

The Silk and Rayon (Artificial Silk) Directory and Buyers' Guide of Great Britain. By Arnold H. Hard. Published by John Heywood, Ltd., London and Manchester (268 pp., 21s. net).

This directory has been well received and its second year of issue has been marked by a rearrangement of its previous sections and an addition of several others. The list of producers of artificial silk has, as might be expected, had to be extended and, in addition, particulars have been added of the types of silk made; the deniers produced in each type; the output, capital, and dividends of the concerns, as well as particulars of their representatives in this country. In a similar way other sections have been enhanced in value by the provision of further information. A chemical section has been added so that by reference to its pages the makers and suppliers of the chemicals used in the manufacture of artificial silk can be ascertained. In so far as this directory gives information of the foregoing character, it serves a most admirable purpose—it is surprising how often recourse has to be made to directories or would be made if such were available. But it cannot be said that there is any justification for articles such as those on "Fabrics without a Loom," and the "Construction and Installation of Artificial Silk Factories," in a directory such as this—their place is in the technical journals, surely. A bibliography of such articles, a glossary of terms, and a tabulation of comparative counts and yarn numbering systems would be well worth a place. It must be conceded that this directory is much required and has thus early shown every sign of fulfilling its functions admirably. —H.L.R.

American Society for Testing Materials: Proceedings of the Twenty-Eighth Annual Meeting. Volume xxv., Parts i. and ii. Published by the Society, Philadelphia, Pa., U.S.A. ($6.00 in paper, $8.00 in half-leather, per part).

These two volumes which, together, consist of over 1,400 pages, contain a very interesting and valuable record of the deliberations of this Society, which has now held no less than twenty-eight annual meetings. While dealing specifically with the subject—"The Promotion of Knowledge of Engineering Materials"—the President, Mr. F. M. Farmer, expressed views which can as well be applied to other materials. "Knowledge," he said, "can be promoted . . . in three ways—By developing and publishing information obtained through research carried on by the Society itself; by publishing information developed by its members individually, and by extending the usefulness of existing information. Through research the circle of knowledge is widened, while through education and publicity the contents of the circle are made available to a larger proportion of humanity and thus become more useful." It is gratifying to read that Mr. Farmer "placed special emphasis" on increasing the usefulness of the knowledge we already have. It cannot be too specially emphasised that the work of a scientific organisation embraces this particular aspect, and it may well be that other organisations have to some extent overlooked this point. Indeed, the whole of this address is of great value to any connected with the development and exercise of the true functions of a scientific organisation, and the American Society for Testing Materials are not only to be congratulated on such an address, but to be thanked for publishing it. The reports of the various Committees of the Society make interesting reading, while that of Committee D13 is especially to be noted here. Four new Sub-committees have been established and three

of them deal with fields of work new to Committee D13, viz. Rope and Cordage, Artificial Silks (Rayon), and Asbestos Textiles. Five, hitherto tentative standards, have been advanced to standard, and these will be dealt with in the Abstracts Section of this *Journal* at an early date. There can be little doubt that the work of this Committee justifies the claim of its Chairman—that a secure foundation for and awakened interest in testing textile fabrics and yarns has been brought about. H.L.R.

Reference to the "List of Publications added to the Library," pages P50–P51, will show that several books of interest have been received. Reviews of these have been held over for lack of space and will be included in subsequent issues.—EDITOR.

GENERAL ITEMS AND REPORTS

Philosophy in the Market Place*

On 26th February the President of this Society delivered an address on the above subject, in the course of which he pointed out that this country was faced in a more acute form than any other with the question of how to maintain a growing population. The crucial problem to be solved was—Could we to-day sell enough goods to pay for what we must import? There were two obvious remedies—(1) To increase the productivity of the soil; (2) to create a greater demand for our manufactured articles. Organised support was given by the State in the search for those remedies. For this end the Department for Scientific and Industrial Research had been formed, and some of the most original minds in the country acted as advisers to that body. The reluctance of the average manufacturing firm to employ a research staff was amply justified because it was extremely expensive. Organised industrial research could only be carried out successfully by great organisations. He used the term "research" in the sense which it acquired during the war. A research department was largely an intelligence department. It must examine all patents which appeared to have a bearing on industry, especially those taken out in foreign countries. If they were of technical merit, experiments should be made to discover something similar in order to meet foreign competition. Quick investigation of every foreign patent bearing on industry was the most important service that an intelligence department could give. It not only suggested analogous lines of research before the value of the invention was recognised by others, but also when the products made under the patent came on the market they could be identified, and it was well to have a "counter" ready. It must be remembered that when a chemical product was once well-established in the markets of the world, it would remain established until a new product offered by a competitor successfully attacked and perhaps replaced it. This kind of work could be called defensive research work. Industrially it was most important. It would be a great saving of effort if all this work could be centralised in the new laboratory at Teddington on behalf of the whole of our Chemical Industries. Speed was the essential thing. Most patents were worthless and could be reported so at once. It was useful even to know that a patent was worthless. Many firms would be glad to subscribe to such a scheme, which would be of direct service to the industrial community of chemists, and could not injure any British manufacturer. The regular publication of reports would demonstrate to the business world the extreme importance of following up the technical and scientific literature of the day. We should be able to develop, for the service of national industry, the wealth of scientific talent which this country fortunately possessed. Newer knowledge would lead to the development of new industries.

Burling and Mending

Mr. Sydney E. Illingworth, addressing the Huddersfield Textile Society on 8th February, on "Burling and Mending" (Mr. Ashley Mitchell presiding), said that whereas in the old days burling and mending was considered part of a weaver's duties, it had now reached a stage when not only had it become a separate

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*From a report supplied by the Secretary, Manchester Literary and Philosophical Society.

department, but even a separate trade. Burling and mending was simply a barometer showing the efficiency or otherwise of weaving, and if a weaving shed was full of burlers and menders, it proved that it was not a properly efficient concern. With the old type of cloth a few ends or picks out made very little difference, as they could be covered up in milling or finishing, but in these days of finely-woven cloths, due to changing fashion and the desire for novelties, it was essential that pieces should be carefully gone over before being sent to the dyer and finisher, and great care had also to be used in the use of needles of correct fineness, proper tweezers or burling irons, and a knowledge of the proper type of cleaning material. The process did not end in the grey, or undyed state, as very often latent faults appeared after dyeing and finishing, such as foreign matter in the yarn, jute, and cotton bagging, &c., all of which had to be picked out, as well as weak threads which gave way in the dyeing or finishing processes. Many dyers kept their own staff of burlers and menders to deal with these faults, but in other cases the pieces had to be returned to the manufacturer to be remedied. There was no doubt that the burling and mending process had added tremendously to the cost of a cloth, and as, in his opinion, fully 50% of the faults found in a piece were due to faulty yarn, he suggested the advisability of burlers and menders being employed by spinners so as to ensure better yarns being supplied to the manufacturer. An improvement in the knowledge as to the ultimate use of a yarn would save a great deal of burling and mending. So far as manufacturers were concerned, much could be done to reduce faulty weaving by seeing that all yarns were properly tested and graded before being used for a particular type of cloth. The tuning of looms should also be carefully attended to, the looms set perfectly level, and greater use made of warp and weft stop motions—particularly the latter. A great saving would be the result. He had seen pieces containing as many as 85 broken picks which would have been reduced to eight or nine had a weft stop motion been employed. In fact, every method possible should be employed to reduce or get rid entirely of a process which now entailed the employment of one burler for every three weavers on two looms, and even in some cases three burlers to five weavers. With regard to the question as to whether burlers and menders should be paid on a piece-work or time rate basis, there was no doubt that burling and mending was a tedious occupation and trying for the eyesight, and on this account time rate was said to be the best method. But a great deal depended upon the class of worker, the type of work, and the conditions, particularly with regard to light, under which the work was being done. When on time rate, it was always a great difficulty to get pieces away to complete orders within the specified time. A better method, which was now in operation and worked quite well, was to combine the two methods in order to get a better production. For example, a piece would be calculated by the employer or forewoman in the department to take a certain number of hours for burling and mending, and the employee would be given a certain price—say a certain percentage above time rate—if the piece was finished within the stipulated time; any time taken beyond would be reckoned on the day rate. —M.

Cotton Yarn for the Bradford Trade

A lecture on "Features of Cotton Yarn for the Bradford Trade" was given before the Bradford Textile Society on Monday, 15th February, by Mr. S. B. L. Jacks (Messrs. R. Greg & Co. Ltd., South Reddish, Stockport). Mr. Sydney E. Illingworth, President of the Society, was in the chair and introduced the lecturer, who said that the Bradford trade required a strong, even yarn, regular in strength throughout and even in counts, clean and clear—one that could stand a considerable strain at all points. The presence of fluff was one of the chief causes of complaint made against cotton yarns to-day, and he regretted that the complaint was more than justified. Before the war they were accustomed to find plenty of hard, wiry cotton in Liverpool, but to-day—even in the best seasons—one had to look carefully round to find it, at least so far as American cottons went. The Egyptian crop was a rather different thing. Strength in yarns resulted from length or strength of staple, and what Egyptian had lost in strength it had certainly made up in length. Yet another serious cause for complaint in Bradford was what he had heard called "spotted" cotton. This was an inaccurate expression; he would rather term it "neppy" cotton. This was a fault to be found

in all cottons and was, he believed, primarily the result of picking the cotton too early before the seed had properly matured. Unless very numerous, these neps would go undetected in the yarn, and when the cotton was used as a warp to a worsted weft, no trace of them would be seen in the finished cloth and no damage was done. But when such a yarn was used for linings, with a cotton warp and weft, and the cloth dyed a dark solid colour, the effect was at once visible and spoilt the whole look of the fabric. A much more serious fault, at least from the point of view of the Bradford trade, was that which resulted from bad and dirty piecings. The spinner when piecing at one stage or another rubbed the two broken ends together with her fingers. If her fingers were dirty or if, in order to make the fibre stick more easily together, she licked her fingers first, a hard lump would be formed in the roving. This might never be drawn out in subsequent processes, or only partially so, and would appear in the finished yarn as a thick dirty end, sometimes extending for so much as three or four inches. Theoretically this fault should not appear where there was adequate supervision of the work, but there was no contending against human nature, and so long as the system of piece rates or payment by output existed, there would always be the tendency for the operative to turn out work as expeditiously as possible, rather than effectively. Another pernicious fault was that known as "single" or "double"—an end running very coarse or fine for some distance and then righting itself. This, in his opinion, was an almost unpardonable crime, but was finding its way all too often into yarn. For some time past he had been gradually coming to the conclusion that for doubled yarn the only satisfactory method of meeting the requirements of the Bradford trade was to produce a knotless yarn. This could easily be done by splicing the ends together, but this necessitated an extra process and a slightly increased production cost. The process consisted merely of untwisting the two ends to be joined together, then splicing the several threads together with a coating of beeswax and twisting them up again. The resulting splice was perfectly clean and imperceptible. This should prove a solution for many complaints in doubled yarns. In single yarns any universally-used system of splicing would be entirely out of the question and add too much to the cost of the yarn. In single yarns, indeed, splicing should not be necessary, a properly tied knot being so small as to be almost imperceptible. In conclusion, he pointed out how vitally important it was for the cotton merchant to understand the needs of the cotton spinner, and for the cotton spinner to understand the trade of the Bradford manufacturer.

—M.

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PROCEEDINGS

TEXTILE INSTITUTE EXHIBITION

KNITTED FABRICS AND NOVELTY YARNS FOR HOSIERY OR KNITTED FABRICS

A three-days' exhibition promoted by the Lancashire Section of the Textile Institute was held in the large hall at the Institute premises, Manchester, on the 18th, 19th, and 20th March. In promoting and organising the exhibition, the aim was to bring together exhibits of newest productions in reference to the particular branch of textile manufacture indicated. Invitations to exhibit were sent out to members of the Institute generally, and those members not directly interested were asked to bring the proposal before the notice of firms with which they might be connected. No charge was made for stand accommodation, and admission to the exhibition was free to ticket-holders or visitors presenting a trade card. The foremost idea associated with the effort was to afford facilities whereby progress taking place in one particular branch of textile manufacture might be readily visualised. The introduction of artificial silk and its utilisation in various ways in the knitting and hosiery industry were prominently expressed in the exhibits presented. Altogether, the presentation formed an interesting illustration of the rapidity with which developments have taken place in the utilisation of artificial silk or rayon. The exhibition was certainly well attended, particularly on the Friday and Saturday, 19th and 20th March, and on the latter date there was a special invitation to members of the British Association of Managers of Textile Works. In the evening a joint meeting of the Lancashire Section of the Textile Institute and the Association of Managers took place, when two short papers were read—one on "The Knitting of Artificial Silk or Rayon," by Mr. George H. Buckley, and the other on "Artificial Silk Sizing Problems, from the Machinists' Point of View," by Mr. W. B. Crompton. The following brief references to the exhibits provide a general idea as to the scope of the exhibition—

Messrs. John Bright & Bros. Ltd. (Carpet Department), Rochdale, showed special yarns printed in a series of shades showing variation of general tone by varying proportions of three different colours. Garments made from the printed yarn were also shown.

The British Celanese Limited arranged a most attractive stand, which displayed various special fabrics and garments made therefrom, and also Celanese hose and Celfect yarns.

Messrs. Copley, Marshall & Co. Ltd., Wildspur Mills, Newmill, Huddersfield, specialised in mercerised yarns, and their exhibit included a great variety of yarns of counts ranging from 2/420's to 2/1½'s, and in addition to two-fold there

were three-fold and many stranded yarns, the last being intended for hand knitting (jumpers) and embroidery purposes. A range of mercerised grandrelles (two-colour effects) was shown in colours fast to cross-dyeing. A special feature of the exhibit was the fineness of some of the yarn, which included 2/420's mercerised and dyed, as against the usual fine counts of 2/200's and 2/180's. Particular attention was drawn to the lustre of the yarns, and it is interesting to note that the members of this firm are the inventors of both the warp and hank mercerising machines which they use. The firm stresses the advantage of the water supply available for their concern as being an important factor in the maintenance of the lustre of mercerised yarns.

Messrs. R. Greg & Co. Ltd., South Reddish, Stockport, arranged their exhibits with a special showcase as a background, the case containing a range of fancy yarns, coloured and grey, in cotton and artificial silk, showing gimps, knops, slubs, and spirals. On each side of the case was a garment—one knitted from artificial silk and cotton, by hand, and the other machine knitted from an all-cotton solid-coloured gimp. Hanks of various styles of fancy yarns suitable for hosiery included coloured cotton gimps as fine as 10 hank. A specially interesting hank was an artificial silk floss yarn in the bleached state of a soft wool-like handle. A few cones were displayed, of which the most interesting was one of spun artificial silk (Vistra) and another of super-combed white cotton presented as a new speciality of the firm.

Messrs. Irwin & Co. Ltd., Manchester, presented several exhibits of their special knitted fabric, registered under the name of "Hopude." Both specimens of the fabric, plain and dyed, and garments and scarves formed an attractive collection.

Messrs. Ickringills (Silsden) Ltd., Silsden (Yorks), exhibited an excellent range of coloured fingering and double knitting yarns; fancy yarns for hand and machine knitting; fancy dyed yarns; and hosiery yarns of every-day requirement.

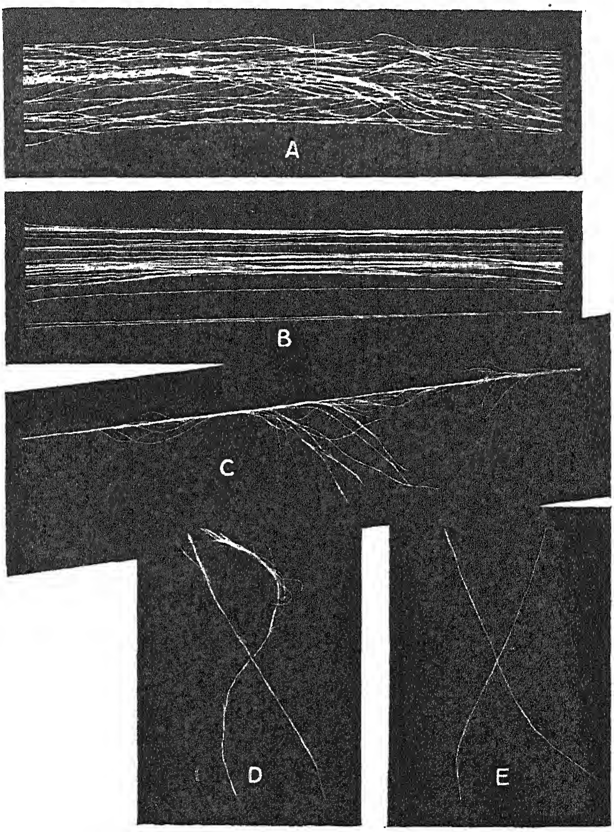
The Strines Printing Co. Ltd. (a branch of the Calico Printers' Association, Ltd.), contributed a fine selection of printed knitted fabrics which were artistically displayed on the platform of the hall. The exhibits included knitted cashmere woollens, plain knitted art silks, knitted art silk crêpes, and various specimens of fancy knitted goods. The printed knitted woollen cashmeres claimed particular attention both for their effectiveness and the compelling character of the designs.

Messrs. Burgess, Ledward & Co. Ltd., Wardley Mills, Walkden, near Manchester, contributed exhibits of cotton and artificial silk yarns as used in the knitting and hosiery trades. Among the cotton samples were cones of 8's-20's hosiery yarns dyed in ordinary and guaranteed fast colours for jerseys, 2-fold mercerised yarns (2/12's-2/20's) in ordinary and guaranteed colours, and 2/30's-2/100's mercerised and sericised, dyed in fast colours for hosiery tops &c. Samples of 2/30's-2/100's in grey sericised yarn were also shown. The artificial silk exhibit contained samples of viscose silk, natural and dyed in various shades, 150 and 300 denier, wound on bottle bobbin, cone, and cheese, for hosiery. Fancy artificial silk yarns were also on view, and included cotton and acetate-silk mixtures; 2-fold spun artificial silk, crêpe and bouclé twist jumper knitting yarns, in plain and rainbow shades, artificial silk marl yarns in two and three colours. Pieces of stockinette knitted from 250 denier and 300 denier viscose were also shown.

Messrs. J. & J. Hardman (1920) Ltd., Farnworth, near Bolton, provided an attractive exhibit of "Vistex" yarns—a mixture of viscose artificial silk and cotton. The exhibitors claim a particularly near approach in appearance and softness to spun silk and to pure silk when a low percentage of cotton is used. The marked lustre of artificial silk or rayon is absent, and fabric made from the yarn has a soft and pleasing texture, whilst it is claimed that it does not shrink. The yarn is stated to be suitable also for pile and cellular fabrics and suitings. It is supplied in counts from 60's down—in cop, cone, or cheese,

Messrs. J. E. Rowbottom & Co. Ltd., New Mills, Stockport, showed an excellent range of fancy yarns, including bouclé yarns for machine knitting in cotton, artificial silk, and in a mixture of both fibres. Onde yarns for a similar purpose from a mixture of wool and cotton yarns were shown, as well as sample cloths showing cross-dyeing effects with these yarns. In addition marl effects in dyed and printed mercerised cotton yarn doubled with white artificial silk, and mixture yarns in wool and artificial silk, were displayed in varieties of count, as well as both in hanks and on cones.

Messrs. Samuel Walker & Sons Ltd., Radcliffe, near Manchester, displayed photographs of a patent sizing machine for the sizing of artificial silk warps, together with samples of warps sized on the machine and illustrating the quality produced in comparison with hank-sized warps. In the case of the machine-sized warps, the filaments were shown closely bound together, whereas in hank-sized warps the filaments sometimes appeared loose and separated. The machine sizes, from beam to beam, a warp consisting of 54 ends only, and up to the usual maximum, according to denier. The diagram herewith is self-explanatory.



A—Portion of a hank showing outstanding filaments.

B—Portion of a machine sized warp perfectly free from outstanding filaments.

C—A partly broken hank-sized yarn; the filaments break one by one.

D—A completely broken yarn of the same type, showing how the whole thread comes asunder.

E—A completely broken machine-sized yarn.

The British Thomson-Houston Co. Ltd., Manchester, demonstrated the firm's "Trutint" electric lighting units, together with "Mazdalux" reflectors for mill lighting, and other specialities in electrical equipment. The firm generously provided special lighting, facilitating the displays on several of the stands.

The Mons Mill (1919) Ltd., Todmorden, had a special exhibit in the centre of the hall—an elaborately built stand containing American yarns in various forms of make-up, and illustrating process stages of manufacture.

Messrs. Edward Hall & Bro. Ltd., Botany Bleach Works, Whaley Bridge, near Stockport, showed samples of bleached and tinted raw cotton in various stages and samples of artificial silk waste and cotton mixtures.

Messrs. Edmund Whittaker & Sons Ltd., Oldham, showed a big variety of fancy-effect yarns, both of cotton, and of mixtures of cotton and viscose and of cotton and Celanese. Garments of knitted fabrics and hose served to illustrate the effect of the employment of the yarns in manufacture.

The Lispro Yarn Co. Ltd., Rochdale, exhibited a number of yarns both in grey, processed, and dyed state, and of particular interest were the examples of dyed material subsequent to the special process in comparison with dyeing after normal treatment.

Lancashire Section

Joint Meeting with the British Association of Managers of Textile Works, held at the Institute, 20th March 1926, Mr. Percy Bean presiding.

The joint meeting was held in connection with the exhibition of Knitted Fabrics and Novelty Yarns for Hosiery and Knitted Fabrics. Two papers were read, and the Chairman called upon Mr. George H. Buckley to read his paper first.

THE KNITTING OF ARTIFICIAL SILK OR RAYON

Mr. Buckley said that there was now no reason to doubt that artificial silk was firmly established in the manufacture of textiles, and it was estimated that 40 per cent. of the weight produced was converted into knitted fabric in one form or another. Knitted fabrics could be placed into two classes—warp fabrics and weft fabrics. To illustrate the former, the lecturer showed a sketch of the Denbigh fabric. The knitting of warp fabrics, he said, was usually carried out on straight bar machines, various types of which might have one or two needle bars, and one or more guide bars, according to the particular type of fabric required Another sketch he showed was of a plain weft fabric, and this illustrated the bending action to which the weft thread was subjected.

Mr. Buckley said that artificial silk was a smooth fibre resembling a semi-transparent glass rod, and the least irregularity in the size or shape of the loop was easily detected. Knitted fabric was a uni-thread structure, and therefore clearly disclosed the difference in denier or lack of uniformity in the yarn. The lecturer described the formation of a course of loops on the hand frame, which, he said, still produced the finest class of goods. He then referred to Cotton's patent frame, mentioning the numerous automatic attachments that had been added for the production of fancy goods. The manufacture of fine knitted fabrics on the circular system had been accomplished on the French or German bearded needle machine for many years. Mr. Buckley stated that in the manufacture of medium and coarse gauge fabrics, latch needles were generally used, and proceeded to describe this particular needle and its action. Many operations in needle making were dependent on the human element, and variations would occur which were a source of trouble to the knitter. These created faults in the fabric which were easily observed, and therefore particular care should be exercised in the selection of the needle. The lecturer emphasised the importance of keeping a uniform tension, which he said should be as low as possible consistent with the amount required to prevent the collapse of the cone. Winding

of artificial silk had to be very carefully carried out. A very efficient arrangement fixed to some winding machines was one which would stop the spindle if the artificial silk from the hank became entangled or obstructed by an improperly tied knot. It was essential that faults which occurred in the yarn should be detected in the winding department, as it was a costly business to find them on the knitting machine. The lecturer concluded by stating that it was advisable to knit artificial silk immediately after winding, as atmospheric changes very materially affected the manner in which it unwound.

The Chairman said that the paper rather appeared to him to differentiate between the sexes. When women used to do all the knitting work, they did it by hand, as they still did crocheting. When men began to take up knitting, however, they invented machines to save themselves the trouble of manual labour. He then asked Mr. W. B. Crompton to read the second paper.

ARTIFICIAL SILK SIZING PROBLEMS FROM A MACHINIST'S POINT OF VIEW

Mr. Crompton said it could easily be seen by anyone handling artificial silk supplied by the spinners of the material, that the thread was composed of a number of filaments laid parallel to each other and with scarcely any twist in the yarn to keep the filaments together, which was not the case with cotton and other textile yarns. For a time artificial silk was almost entirely used as weft, and its suitability for warp was first obtained by making a two-fold thread with a fair amount of twist. Twisting artificial silk either in the single yarn or in the twofold provided a stronger yarn more resistant to wear at the cost of a corresponding sacrifice of the lustre, and therefore it was determined that to obtain the full lustre in the warp some method must be found of so preparing the more open yarn that fibres were protected from breakage in the process of weaving, and that they might spread out and give both cover and lustre in the finished fabric. The problem was rendered more difficult by the characteristic features of the ordinary artificial silk thread, viz., that it weakens when in a moist condition, and also that it elongates considerably under the same condition, though it contracts and strengthens as it dries.

In dealing with sizing, the lecturer said that many of the ordinary methods of sizing had been attempted, among which were cylinder and hot-air methods of slashing cotton warps. It was natural that these methods would prove unsatisfactory because of the long stretch while in its wet state, which caused strain in the yarn when in its weakest condition. Yarn sized under such conditions was bound to suffer in strength even if the working condition and sizing results could be considered satisfactory. Hank sizing had been tried, and in this connection many experiments had been carried out. Hank sizing left the threads in a suitable condition for winding, but Mr. Crompton was of opinion that so far this method had not proved satisfactory for weaving purposes. In his opinion artificial silk yarn to be suitable for weaving should be rolled into the size in such a manner that the thread was left with no outstanding fibre or filament, and that when a dry thread was taken between the finger and thumb of both hands and an attempt made to twist and untwist it, the whole yarn should simply turn and hold together, and none of the individual filaments become separated. In order to obtain these conditions, a specially designed machine was obviously needed; at the same time the machine should be as easy of manipulation and of access to the yarn at every point as it was possible to make it. Mr. Crompton then showed photographs of a machine made by Messrs. Samuel Walker & Sons, of Radcliffe, in which he thought these objects were successfully achieved. He went on to describe the machine, and in what manner it achieved the desired ends in sizing artificial silk yarn. A machine of this type, Mr. Crompton said, was very adaptable for different classes of work, and by the adoption of a slight traverse motion the silk could be laid perfectly even on the roller

with very few threads in the warp, as few as 54 having been successfully treated. By opening out the yarn in a front stationary reed a group of bobbins could be filled for use in Dhootie borders, or by spacing in the reed, unevenly spaced stripes could be built up on the weaver's roller successfully, provided each was equally dented in the reed, and paper used freely to bind the silk stripes together.

Discussion

The Chairman said that the two papers had been extremely interesting. One of the points raised in Mr. Crompton's paper showed how things that were detrimental in certain cases became of advantage in others. Many of those present would know that one of the troubles in tape sizing, in dealing with coloured borders, was the dreadful trouble of twirling. In this case it seemed that the small degree of twirling set up was of very great service in the sizing and subsequent weaving of artificial silk. It was probable there were still a great many difficulties to be overcome in the sizing of artificial silk. Elongation during sizing and stretching in the loom during weaving were points requiring very careful consideration by all people concerned with artificial silks.

Mr. Buckley, speaking with reference to the effect of moisture on rayon, stated that atmospheric changes when the rayon was under tension, i.e., when it was being wound on the bobbin, very materially affected the manner in which it unwound. For this reason it had been found advisable to knit rayon as soon as possible after winding and not let it stand.

Mr. Farrow said he had seen the machine described in actual running. The conditions of drying were very different from those of tape sizing. The contact with the hot metal was very much shorter and much less efficient. It would be interesting therefore to know at what rate the machine was run, also the strength of the size and so on. Could they be told at what speed the yarn was run on to the beam ?

Mr. Crompton said that it would vary. If there was a fine denier, which would dry quickly, and the result depended partly on the drying efficiency of the machine, the speed would be, approximately, about 5-7 yards per minute.

Mr. G. Dougill inquired whether Mr. Buckley had any preference in knitting yarns in having the twist in the yarn twist way or weft way ?

Mr. Buckley replied that, as far as he knew, in the knitting of fabric no change was required to be made in the direction of the twist. He thought, generally speaking, that was only necessary in the making of lace, which was, of course, a twist fabric and not a loop fabric.

Mr. Dewes stated that to the circular hose machine, which was so much used in Leicester, there used to be fitted a small bottle which contained a little wick and some oil. The thread passed over the wick and got a very intimate coating of oil. The knitters felt the want of something of the kind, and while some of them struggled along with this particular method others abandoned it. Could Mr. Buckley say, from his own experience of knitting artificial silk yarns, whether such a method was advantageous ?

Mr. Buckley replied that there was no question about it—that the lubrication ought to take place before the yarn was put on the knitting machine. Woollen yarns were soaked and centrifuge-extracted, in which case, of course, "lather" was used; but any tension which was applied on the knitting machine by lubricating was to be avoided as far as possible. The less tension, or rather the more control of tension, that could be exercised over the yarn from the bobbin to the needle was certainly best on the knitting machine. Rayon was lubricated in hank form and wound. It was sometimes necessary to increase the lubrication. This, of course, had to be done on the machine, but as far as possible it should be avoided.

Mr. A. B. Shearer thought that the last question put and its answer also had relationship to sizing for weaving. He was satisfied that the definition given by Mr. Crompton of satisfactory sizing was not quite correct, because it

was fairly obvious that if the only test was the clinging together of the individual filaments that sizing the warp with fish glue would come up to the definition of being an efficient size, which, of course, was obviously incorrect. What the last question really implied was the emulsifying or the providing of some sort of lubricant used for the yarn, whether it was going through a knitting machine or going through a loom. Personally, he held the opinion that an efficient size for weaving had to be at least as much a lubricant as it had to be an agglutinant for the purpose of holding the fibres together.

A member inquired whether the machine mentioned by Mr. Crompton could be seen under working conditions. Mr. Crompton had spoken about sizing 54 ends on the machine from beam to beam, while at the same time the ends of the yarn when wet were very weak indeed. Fifty-four ends did not seem strong enough to pull the beam round.

Mr. Crompton replied that there was an arrangement whereby the machine could be inspected by anyone who was inclined to purchase one. It had been working successfully for some time. With regard to the 54 ends and the weakness alluded to, he had pointed out that the yarn was in the size for so short a distance that there was very little risk of elongation. The yarn was on the machine, and practically drying, before there was any weakening effect such as would be expected in the ordinary way. Yarn had been sized with 54 ends, and evidently it had been woven satisfactorily because there had been no complaints. The beam could be very lightly adjusted.

Mr. S. Watson proposed a vote of thanks to the authors of the two papers, and to the chairman for presiding. He was very much struck with the distinct advancement which had been made in knitted fabrics. As cotton yarns were used extensively in knitted fabrics there should be a corresponding benefit to Lancashire. Judging from what they had seen at the Exhibition an effort would certainly have to be made to cope with the ever growing demand for knitted fabrics. It was up to Lancashire to produce the yarn for them, and consolidate another phase of the cotton industry. He wondered if it would be possible to use a printed cotton yarn and make a floral effect in the knitted fabric? He thought it would be. He had given the matter considerable thought, and believed it was possible that printed cotton yarns could be employed in knitted fabrics, and picked up by some Jacquard mechanism which would combine a knitted effect with a floral design. It would be a step forward, and, of course, being a step forward would go against weaving; but at the same time it would perhaps increase the further demand for cotton yarns. He had been very much struck, when examining some cloth the previous day, by a mixture of cotton and viscose and also of Vistra. The suppleness of the cloth was quite remarkable, and it was not at all a matter of surprise to find there was a large demand for such a fabric. The amount of elasticity and retentive elasticity was remarkable. Of course this was owing to the foundation of cotton, and the Vistra or viscose being spun along with the cotton. The metallic effect which was apparent in all artificial silks was neutralised to some extent. Artificial silk, when spun with cotton, created air pockets in the thread, the consequence being a better article of clothing as regards warmth, even than with artificial silk alone, and also a better wearing surface. It would be disastrous for the thread to roll in cotton sizing; but he could see that if by some mechanism the rounding off of the thread in cotton yarn could be secured it would be of distinct advantage, because there would be a clearer thread and a clearer weave.

Mr. A. Mitchell Bell seconded the vote of thanks. He had listened to both papers with keen interest, the result being that he had not quite such hard feelings as he might have had some time ago. Early on in his career it was his lot to produce certain types of atrakhan fabrics. His firm had got going nicely, and had opened a market for the fabrics, when one of their competitors came along with a type of astrakhan fabric produced upon the knitting frame which

completely knocked out his firm in price. In order to cope with this competition, a number of knitting machines were installed for the purpose of producing a similar type of fabric and regaining the market. At that time he was under the impression that the knitting machine would not be able to produce a wide variety of designs. It was now quite evident that there was a great scope for such machines, and that there were many possibilities in the direction of new designs. Had Mr. Buckley had any trouble with cracked threads, because in the cloth trade, in introducing artificial silk as stripes, and so on, it was found that in the finishing of the fabrics a number of the threads cracked? When there were a number of cracked threads the customers were not slow in complaining about them.

The vote of thanks was heartily accorded.

London Section

Discussion Meeting in the Institute's Rooms, 38 Bloomsbury Square, W.C.1., 3rd March 1926, Capt. S. E. J. Brady in the chair.

SOME PROBLEMS OF THE WORSTED TRADE

Capt. Brady introduced the lecturer, Mr. T. Bray, who said—The problems which beset manufacturers of worsteds are perhaps more numerous than in other sections of the textile trade, because of the many processes that are necessary before the yarn can be woven into cloth. The tendency of the past generation or two has been all for specialisation in the various processes; thus, instead of manufacturers taking in the raw wool and turning out the woven piece, we have separate concerns engaged on each process. The spinner buys his top from the comber (who to-day has reached a very fine art in blending his tops) and draws and spins it into yarn. The drawing process through which the fibre passes actually includes some nine progressive stages. The roving is drawn out by passing between two sets of rollers, the front pair going round quicker than the back, until it is drawn sufficiently for the spinning thread. The yarn is then spun to the required counts, this being regulated by the speed of the rollers; the quicker the speed, the thicker the counts. The spinner has many pitfalls, one being that quality deteriorates if he tries to get too fine in the counts. Sometimes the blending of the top has not been quite what he expected, and it is only when he gets to the spinning frame that the real test comes. A bad spin, that is, constant breaking of threads, &c., is a difficulty the weaver oftentime has to contend with. Specialisation has its advantages, not only for the manufacturer, but for the trade in general, as it gives the manufacturer more freedom in choice, and, again, the fruits of research and experience gained from the study of each separate process can be fully utilised. There is every desire on the part of all sections to turn out as perfect an article as possible, though it is much easier to weave a well-balanced 18 oz. merino or botany from a 70 top, 3 by 3 twill, than from a low cross-bred or some of the fabrics for ladies' wear. This problem of turning out a well-woven piece is sometimes a source of great anxiety to the operative. Weaving is a much more highly skilled operation than many seem to believe. The weaver and overlooker together often have to overcome many difficulties the seeds of which have been unwittingly sown in previous processes. Some distributors seem to have the idea that piece goods can be turned out with the exactitude of cigarettes or pins, simply because machinery is used for each process. Let us for a moment go into detail. As you are aware, raw material for the worsted trade includes not only a big variety of wools from the sheep, but also alpaca and mohair. For some time the British Wool Association has been trying to press home to the sheep farmer, particularly in the Colonies, the need for careful packing of wool. Any kind of common canvas used to be considered good enough for packing, and wool, being very adhesive, attracted loose vegetable fibres and burrs from the

canvas, and these do not come out completely in spite of all the processes to which the wool is afterwards subjected. They are often not seen until the pieces are dyed and finished. The result is that the cost of burling pieces is a very serious charge to manufacturers, varying often from 2d. to 6d. per yard. There are signs that the work of the Association is bearing some fruit, and I believe some schemes are already afoot to remedy this defect. Of course some wools are by nature burry, and on that account must be carbonised, which seems to take a good deal of the life out of wool. It must always be remembered that wool is an animal fibre, which probably accounts for the variety in quality and handle. Another very important process which, if not carefully carried out, has a bad effect on the pieces, is that of wool-washing, and here scientific research and experience have played, and are playing, a very important part. Care has to be taken to use the right soaps, and that water is at the proper temperature. Not only has the grease to be extracted, but the residuals must be cleared as well, or the remedy would be worse than the disease. This work is done by the comber, who after sorting the wool into qualities, passes it on to the wash bowls, after which it is dried and prepared for combing. It is in the combing where blends of qualities are made, and it is somewhat difficult to fix a standard. The safest way is for the manufacturer to fix his standard from his experience of the finished article. It is generally assumed that qualities are fixed according to spinning properties, but to-day that is not so. When a spinner buys what is known as a 60's top, that is the lowest merino, one might think he could spin it to 60's, but 2/48's would in all probability be the limit. To spin to 60's, the spinner must get a good 70's top. The lecturer here defined the bases of the worsted, woollen, and cotton counts. He then said—Blending from various qualities of merino has reached a very fine art, so much so that in fine counts it is easy to estimate a quality, but in thick counts it is much more difficult to place. This is achieved mainly by constant experience of handling the cloth. I have mentioned the processes which occur before the yarn is ready for the weaver, because the test for good preliminary work is in the looms and the finished piece. Taking into account the number of hands through which the material passes in the worsted process, it is astonishing that the degree of excellence is so high. This has only been brought about by the co-operation of all engaged—comber, spinner, and weaver—all of whom must be very highly skilled. I have met distributors who had little knowledge of these matters, and it is most difficult to make them understand. On the other hand, the distributor who has taken the trouble to learn something of the textile industry is usually not only amenable to reason, but able and willing to co-operate with the manufacturer in matters affecting his requirements. I am afraid that so far as textile shipping is concerned London is not so much the distributing centre as formerly, simply because the shipping houses of Bradford and Manchester are in the main staffed by men who have been cradled in the trade. I can understand this to some extent as many London shipping houses do not confine themselves to textiles, but export many other commodities. It is not to be expected that they will be conversant with everything, but I submit that many shipping house buyers could, with profit to themselves, co-operate more with the manufacturers than they do. For instance, the distributor could help very materially to reduce costs of production by studying the needs of the particular market in which he is interested, so that he knows what is wanted. At present he asks for patterns without giving much indication as to what is required, with the result that innumerable patterns are wasted, all of which goes down to expenses of production. This reminds me of the important question of costing, which demands careful attention on the part of the cloth manufacturer. No rule-of-thumb method will do here; he must know exactly what a particular piece costs to make. Of course all sections must face the same problem, but the weaver especially, when buying his yarn from the spinner,

has many things to watch, as, for example, weavers' wages, and actual counts of yarn supplied as compared with those ordered. Overhead charges to-day when compared with pre-war charges are evidently one of the important causes of higher prices. Local rates have advanced very considerably, and so has every commodity used by the manufacturer. If he can keep his machinery running and his production up he is all right, but if he cannot keep all his machinery going, his profit per piece is seriously reduced, often to vanishing point. All good manufacturers desire to keep the wage level as high as possible, for a country's wealth is measured by the spending power of the people. Reduction in costs can only come about by careful management and the elimination of waste by workpeople, apart, of course, from the question of reduction of rates and taxes. The comparative efficiency of the workman is an important factor in calculating the cost of weaving, more so than in any other branch. It is safe to say that as a rule we do not get more than an average 60% of the possible full production of the loom. A manufacturer must know his output before he knows his cost accurately; the better the piece weaver, the less stopping of the loom and the greater the production. A curious point with regard to figures of output in weaving is that greater production is often reached at certain periods, especially when no artificial light is required. The two or three weeks preceding a holiday are also remarkable in this respect; weavers, as you know, get paid according to their production. Wools vary in length from $1\frac{1}{2}$ in. to 17 in. and in fineness from 1/200th to 1/2,000th part of an inch, and these variations demand different treatment. Apart from the Continental system, there is not a very wide choice of machines. The Continental spinners have studied the manufacture of worsted yarns from short wools very thoroughly and with profit. Since the war we, too, have made progress in this direction. As I have already pointed out, the shrinking properties of wool vary very considerably, not only according to quality but according to the build of the cloth. A manufacturer, when he makes a new cloth (usually a pattern), must keep a record of the width in loom, the finished width, and length. Some one has said that 75% of accidents are traceable to human errors; it would be safe to say that this is very true of textile manufacture. The cost of the suit you are wearing is all labour, after the initial cost of the raw wool, soaps, oils, dyes, &c., has been met. Tracing mistakes and faults in pieces is very interesting, for even experts can be led astray. I knew one case where a piece appeared to be "warp-stripey," and we thought two different runs had been mixed in the warping. The dyer took back these pieces to remove crimps which were in the cloth, and when they were returned we found the striping had vanished, much to the satisfaction of the manufacturers. Nobody seemed to know what the trouble had been. Common weaving faults are as a rule traceable, but if a piece weaves badly we cannot always blame the weaver; one must go further back. A fault may have its root in the combing, the drawing, or the spinning, and if in the combing the spinning will aggravate rather than improve the weakness. From a microscopical standpoint the first perfect piece has yet to be made, but I am certain that the standard of weaving was never higher than it is to-day. The art of fault-finding has also reached a very high level, and sometimes customers set an impossible standard. There is an important point I want to raise concerning the quality of worsteds. As you are aware there is merino *and* merino, and the same remark applies to cross-bred. There is nothing easier than to lower quality in an 18 oz. botany. The distributor or merchant thinking a quotation dear, gets cheaper patterns from another source, and may select one. This may be repeated from yet a third source, and, while there may be not much difference between the first and second, or the second and third patterns, the difference between the first and the third would be obvious to the merest novice. If patterns from animal fibres are kept carefully between boards, they improve, and this very often creates a serious problem for the manufacturer. It is sometimes very risky to take orders with old patterns as standards, as nothing but

time will give the soft mellow handle of an old pattern. When orders come along with the old pattern as standard, we have been unable to get quite what was required, in spite of the finisher's art. Particularly is this the case with mohair and alpaca. The time-factor is very important when dealing with mohairs. In two yarns spun from the same top, one in which care had been taken to keep the roving for about three weeks before spinning, and the other which had been rushed through without allowing the roving to stand, there would be a great deal of difference; that which had been rushed through would be uneven, and look in places as if ready to burst. Curious though it may seem mohair tops improve with keeping; the best results will not be obtained unless plenty of time is taken over the processes. This is very difficult when a manufacturer is given a limited time for delivery in order to catch the season's trade; I mention this in reply to much criticism that has been levelled at the worsted manufacturer for his delay in delivery. Research work on mohair is being conducted in order to find some remedy for this delay, so that the spinner can go straight ahead without wasting so much time. The anxiety to keep up to date is very real, and experiments are constantly being made in top building and designing. The latter is a source of expense little realised by the distributor, for scope is almost unlimited in both the coating and the dress trade. Unfortunately the initiative usually has to come from the manufacturer, the exception being when the merchant has taken the trouble to understand something of textiles; a point I have already raised. As a rule, shipping houses merely ask for patterns without giving any suggestions of modifications for particular markets. The average manufacturer is not behind the times, but many distributors still rely on the old method, and take in all the patterns a manufacturer can send without thinking of the cost. Those who are progressive enough to know their own market requirements and who have initiative are doing a better trade. Our manufacturers of dress fabrics have been accused of not keeping up to date with Continental makers, and of not making full use of the dry spun yarn from short wool. It must be remembered that cap spinning is most suitable for the production of yarns for worsted coatings and the better grades of ladies' costume cloths. Our spinners have held the field in this particular class of spinning, and spinners on the Continent have adopted dry spinning because they cannot compete with our cap spinning. This was the only way in which they could come into the market with lightweight dress fabrics. One of the features of dry spun yarn was that the dyer could get more delicate shades than with cap spun, which is spun in oil. To-day very delicate shades can be produced with cap spun yarns quite equal to any of the dry spun yarns. It is admitted that fine single mule-spun yarns are cheaper than the equivalent counts in two-fold cap spun yarns, but advances have been made in developing the mule-spinning side in England in spite of the fact that in pre-war days some of the spinners who put down such machinery had their fingers burnt severely. However, such progress has been made by the co-operation of spinners with dyers that many dress fabrics turned out in the Bradford area to-day are equal to, if not better than, the best productions of the Continent. There is much variation in the affinity for dyestuffs among the many different qualities of wool, and after dyeing several pieces together for one shade, it may be found that they vary considerably. We find it very difficult to convince the distributor that it is not always possible to repeat exact shades. We can get approximately near, but we cannot always match so that no difference whatever is discernible. I have only touched the fringe of many topics of this industry, each branch of which is seething with problems. Those of you who were fortunate to hear the lecture by Mr. Fry on "The Production of Design in Fabrics," a subject I have left severely alone, will remember that he could not get through half he wished to say in the time available. I have tried to give a general outline which, I hope,

has been of some interest, and I hope that some parts at least may be useful to you; if so, I am more than compensated for taking up your time.

After a very short discussion, the Chairman moved a vote of thanks to the lecturer, which was carried with acclamation.

NOTES AND NOTICES

Diplomas of the Textile Institute

First Instalment of Awards of Fellowships and Associateships

The first instalment of awards of Fellowships and Associateships of the Institute, under the scheme indicated in the Royal Charter of Incorporation, and under the conditions governed by the bye-laws, was presented at the annual general meeting of the Institute on Wednesday, 21st April. The first Fellowship was presented to the retiring President (Mr. John Emsley, J.P., of Bradford) at a special function at Bradord on the 25th January last, whilst the second Fellowship was separately awarded to Mr. J. H. Lester, M.Sc. (Chairman of the Selection Committee) at the annual meeting already referred to.

The full list of Members of the Institute who have now been elected Fellows and Associates is as follows—

FELLOWS

JOHN EMSLEY (Bradford), President of Institute, 1922-3 to 1925-6, First Fellow.

JOSEPH HENRY LESTER (Monton, Eccles, near Manchester), first Chairman of Selection (Diplomas) Committee, Second Fellow.

ADAMSON, John Evan (Accrington).
ANDREWS, Michael Corbet (Belfast).
ATKINSON, Ellis (Bradford).
BAILEY, Reginald Greenwood (Bradford).
BAILEY, Walter (Ashton-under-Lyne).
BARKER, Aldred Farrer (Leeds).
BARRETT, Frank Leslie (Davenport, Cheshire).
BARWICK, Fred Wilkinson (Manchester).
BELL, Arthur Mitchell (Halifax).
BINGHAM, Thomas Ernest (Ashton-on-Mersey, near Manchester).
BINNS, Henry (Bradford).
BOOTH, John (Glossop).
BOOTHMAN, William Thomas (Duxbury, near Chorley, and Bolton).
BRADBURY, Fred (Belfast).
BRADY, Sydney Edward Joseph (London).
BRIERLEY, Sam (Huddersfield).
CHADWICK, Fletcher (Rochdale).
CHAPMAN, Albert Martin (Burley-in-Wharfedale, near Leeds).
CROMPTON, John (Lytham and Manchester).
CROMPTON, William Bickerton (Walkden, near Manchester).
DAWSON, James Henry (Brierfield, near Burnley).
DENISON, Joseph Richard (Bradford).
DUMVILLE, Joseph (Bradford).
ENGLISH, Walter (Buenos Ayres, Argentine).
FOULDS, Robinson Percy (Manchester).
FOULDS, Thomas (Colne, Lancs.).
FOX, Thomas Alfred (Gomersal, near Leeds).
FRY, Ernest Bickersteth (London).
GARNETT, George (Bradford).
GARRETT, Albert Edward (London).
GREG, Henry Philips (Styal, near Manchester).
HALL, Oscar Standring (Bury, Lancs.).
HEAPS, William (Bolton).
HENDERSON, Sir William (Dundee).
HEYLIN, Henry Brougham (Tilehurst-on-Thames, Reading).
HILL, Harold (Bolton).
HOLDSWORTH, Ernest Thornton (Bradford).
HOLLINGS, Samuel Banks (Bradford).
HOPKINSON, Frank (Bradford).
HOWARD, John (East Sheen, London).
JAFFÉ, William Edward Bertold (London).
KERSHAW, Samuel (Bradford).
KIRK, William Watson (Colne, Lancs.).
McCONNEL, Frederic Robert (Manchester).
MASON, Arthur (Macclesfield).
MIDGLEY, Eber (Bradford).
MILLS, Lord John (Surbiton, Surrey).
MOORES, George (Chorlton-cum-Hardy, Manchester).
NASMITH, Frank (Manchester).
NISBET, Harry (West Didsbury, Manchester).
PENNINGTON, John W. (Burnley).
PERL, Alfred George (Vienna, Austria).
PORTER, Frederic Charles (Lytham).
PRIESTLEY, Edford (Farsley, near Leeds).
READ, John (Monton, Eccles, near Manchester).
ROBINSON, John (Denholme, near Bradford).

ROBINSON, Thomas Fletcher (Pendleton, near Manchester).
SAVILLE, Arthur (Bradford).
SCOTT-TAGGART, William (Bolton).
SHANNON, Francis John Wesley (Belfast).
SHAW, Arthur (Macclesfield).
SHEARER, Andrew Blair (Kersal, Manchester).
STAFFORD, George Harold (Hyde, Cheshire).
TAYLOR, Samuel (Littleborough).
WARNER, Sir Frank (Mottingham, London).
WATSON, Samuel (Hyde, near Manchester).
WATSON, William (Glasgow).
WHARTON, Thomas Richard (Wilmslow, Cheshire).
WIGGLESWORTH, Edwin (London).
WOODHOUSE, Thomas (Wormit, Fife).
WRIGHT, Frank (Bolton).

ASSOCIATES

BARKER, George (Ben Rhydding, Yorks.).
BARR, Joseph (Nottingham).
BEATTY, George Rooston (Coalisland, Co. Tyrone).
BRAND, Alexander (Arbroath).
BURROWS, Stanley Lees (Hawick).
CAIRNS, William Hewitson (Bradford).
ESSAM, John Maltby (Manchester).
GEARY, Andrew Roy (Dunfermline).
GREENWOOD, Robert Stansfield (Bradford).
HALSTEAD, Frank (Burnley).
HARDMAN, Alfred (London).
HAWORTH, Frederic Wilson (Nelson).
LEWIS, Albert Easton (Manchester).
MICHIE, John Livingston (Hawick).
MILNES, Alfred Hallett (Timperley, Cheshire).
MORTON, William Ernest (Didsbury, Manchester).
NUTTER, Handel (Nelson).
ODDIE, Edward (Burnley).
OLIVER, James Henderson (Hawick).
OVERSBY, Reginald Greenwood (Bradford).
RAYNER, Slater (Bradford).
REIDY, John William (Manchester).
RUSHTON, George Albert (London).
SCHOLFIELD, John Albert (Todmorden).
SHACKLETON, William Taylor (Westhoughton, near Bolton).
SHARP, Frederick Irvin (Glossop).
TRUESDALE, Reginald (Birmingham).
WILKINSON, James Arthur (Burnley).
WRIGHT, William Henry (Swinton, Manchester).

Annual Conference at Buxton

Arrangements are proceeding in regard to the next Annual Conference of the Institute, which is to take place at Buxton during Whit-week, and members generally are asked to make every endeavour to attend. It is expected that the proceedings will commence on the Wednesday evening of 26th May by a social assembly. On the morning of the 27th May the Conference will open at the Town Hall, and a prominent feature will be the delivery of the Mather Lecture by Sir William H. Bragg, K.B.E. The afternoon and evening will probably be left free to members to pursue engagements according to inclination, and in this connection it is hoped that special facilities for golf may be available. On Friday, 28th May, the Conference will be resumed (morning session), and in the afternoon it is proposed to organise a drive—probably to Macclesfield—where it is hoped to be able to inspect one or two textile works. It is fully expected that many members may decide to spend their Whitsun holiday at Buxton. The railway companies have declined to grant special railway fare facilities, but the general holiday and tourist fare arrangements of the companies can be taken advantage of, whilst many members will doubtless travel by road. Hotel and other accommodation for visitors is quite extensive at Buxton, and particulars will be in the hands of members by the end of April.

London Section Activities

The Annual Section Meeting of the London Section was held in the Institute's London Rooms, 38 Bloomsbury Square, W.C., on Thursday, 15th April, at 6.0 p.m. Mr. Edwin Wigglesworth, the retiring chairman, in a *resumé* of the year's work, mentioned that at length the Committee, with the help of some useful criticism from Mr. J. H. Lester, had formulated a particular policy for the London Section, subservient to the general policy of the Institute, and that it was the

intention of the London Committee to give wide publicity to this policy. Arising out of decisions at the Section meeting, a visit is being arranged to inspect the hosiery works of Messrs. Dix, Watson & Co. Ltd., of Alperton, Middlesex, some time early in May. It is hoped to arrange a similar visit to a weaving factory later in the summer. Arrangements have also been made for an Exhibition of Fabrics, woven under Bradford Textile Society's Prize Scheme at Bradford Technical College, to take place in the Institute's London Rooms on Wednesday and Thursday, 12th and 13th May 1926. Representatives of London textile distributing houses are to be invited to inspect these fabrics and offer criticism.

Annual General Meeting—Council Election

Our report of this event (21st April), covering the election of President (Mr. William Howarth, J.P.) in succession to Mr. John Emsley, J.P., the election of Vice-Presidents, and the result of the ballot for election to ten vacancies on the Council, cannot appear until next issue owing to the narrow margin of time available for printing. The result of the ballot for election to Council, however, may be recorded. The following were elected—T. Fletcher Robinson (Manchester), Henry Binns (Bradford), Frank Wright (Bolton), E. B. Fry (London), W. E. Baker (Manchester), H. Richardson (Bradford), A. Pollitt (Manchester), E. E. Cockcroft (Luddendenfoot), C. S. Ickringill (Bradford), and W. W. L. Lishman (Todmorden).

Appointment to Chair of Textile Technology—Manchester College of Technology

Mr. W. E. Morton, who has been appointed to the University Chair in Textile Technology in the College of Technology in succession to the late Professor W. Myers, was educated at St. Bees School and at the Manchester College of Technology. He graduated B.Sc.Tech. with First Class Honours, and in the next year obtained the degree of M.Sc.Tech. by a research on Fabric Structure. Since then he has been on the staff of the Cotton Industry Research Association at the Shirley Institute, Didsbury, Manchester, where he has been particularly concerned with the technical side of the problems which it is the object of that Institute to solve. Much of his time has thus been spent in numerous mills investigating the practical side of problems which the Shirley Institute has then to deal with on their scientific sides. Not less important has been his work of interpreting the scientific results of the Institute to the cotton industry, and of maintaining a close liaison between science and industry. The experience thus gained should be valuable in his new appointment, where he will be responsible for the training of many of the young men to whom the industry will look for future development. Mr. Morton has himself contributed to the new knowledge of raw cotton and yarns, which the Shirley Institute is acquiring for the benefit of the cotton industry; he has first-hand knowledge of Continental methods, and he represents the Cotton Research Association on the Government Committee on Aircraft Fabrics. Mr. Morton is a member of the Textile Institute, and was an early and successful candidate for its Associateship.

REVIEWS

Dyeing with Coal-tar Dyestuffs. By C. M. Whittaker, Bailliere, Tindall & Cox, London. Second edition 1926 (x. +248 pp., with Index, 2 plates. 10s. 6d. net).

It was at once evident when the first edition was published about eight years ago that this book would fill a definite gap in the literature available to practical dyers, and the appearance of this second edition shows that its value is appreciated. The author has succeeded in bringing his book up-to-date, and the recent developments in azoic and vat dyestuffs have received attention. However, so few changes in methods of dyeing have taken place recently that the new volume is largely a reprint of the earlier one. The application of basic, acid, mordant, direct, azoic, sulphur, vat and oxidation dyestuffs to all classes of textile materials including union fabrics, jute, straw and fur, is described in a thorough and practical manner. In view of Mr. Whittaker's experience in the dyeing of artificial, particularly viscose, silks, it is important to note that the new edition contains a well written and comprehensive account of this new branch of dyeing. Practical dyers of artificial silks will find this portion of the book particularly valuable, although the space devoted to cellulose acetate silks is somewhat brief.

A few features of the book invite comment. In view of the practical character of this work one would expect dyeing faults to receive greater attention. It is true that methods by which faulty dyeing may be avoided are described, but a dyer confronted with spoilt goods is very thankful to anyone who can assist him to trace the faults and indicate how they may be corrected. It is surely a mistake to suggest (page 70) that cotton piece goods are usually crabbed before dyeing, and it is doubtful (page 116) whether white worsted border fabrics are nearly always mercerised, especially before dyeing with sulphur black. Although the author disclaims any special knowledge of Turkey red dyeing, it is scarcely fair to omit the summary of methods contained in the first edition and then refer readers to out-of-date manuals. In connection with colloid theories of dyeing (page 63), attention might well have been directed to the interesting researches of R. Auerbach and R. Barlunek.

It should be made a punishable offence for modern technical authors to make quotations without giving the corresponding references; this applies to the American census mentioned on page 121, and it should furthermore be noted that figures relating to the British production of dyestuffs for 1924 have been available for several months. The reviewer does not agree that the difficulties of dyeing cotton-cellulose acetate silk union fabrics in two colours to desired shades requires the adoption of a two-bath process, with its accompanying extra cost. In view of the statement (page 181) that cotton material being dyed Aniline Black by the copper process is dark green after ageing, it must be a slip on page 182 which leads the author to state that fabrics dyed by the prussiate process are less fully developed after steaming; steaming carries the formation of Aniline Black to a very advanced stage. The tests described on page 241 for distinguishing between sulphur, direct, logwood, and Aniline Blacks should now include Azoic Blacks, and many readers would welcome more information than is given relating to methods for dyeing furs. The book is thoroughly recommended to all interested in dyes and dyeing. A. J. H.

The Wool Year Book 1926. Marsden & Co. Ltd., Manchester (pp. 583, price 7s. 6d.).

The compiling of an industrial Year Book is no mean task; the constant modernising of such a publication must entail an enormous amount of work. The energy expended in the production of the Wool Year Book has been amply justified; it maintains its usual high standard and well merits its position as a work of reference. An interesting annual review of the worsted and woollen industries is provided, and the various sections of the book dealing with raw materials and their conversion into yarns, fabrics, and knitted goods are extremely well written. The chapters on bleaching, dyeing, printing, and finishing contain the right amount of information to enable spinners and manufacturers to understand the nature and functions of the various after-processes through which their goods pass. The general "get-up" of the 1926 edition is, as usual, beyond reproach. Diagrams are well reproduced. A useful amount of statistical

information is given, and the clear exposition of trade customs and usages will be of value to those engaged in the allied textile industries. In the sections dealing with textile calculations, every effort has been made to render the various processes readily understandable. When one compares the somewhat crude mathematical efforts of the textile technologist with the more highly polished and efficient methods of the physicist and engineer, however, one feels the need for the inflexible inclusion of a course of higher mathematics in the training of the former. F. L. B.

Some Parasites of British Sheep. By W. C. Miller. Robert Young & Co. Ltd., Glasgow (price 2s. 6d.)

This small book makes available the essentials from one branch of zoology that bears on the textile industry. It deals with the British insect and arachnid parasites of sheep, as well as certain other afflictions of those animals, especially those which can be treated by dipping. The writer is a lecturer in the Royal (Dick) Veterinary College and in the Edinburgh and East of Scotland College of Agriculture. The book is brought out by a well-known firm of manufacturers of sheep and cattle dips. It is estimated that the loss accruing annually to the British sheep farmer—loss of condition in the sheep themselves, damage to hides and wool, or actual deaths—is not less than £2,500,000, although this loss is spread over a sheep population of some twenty millions. There is thus a short limit to the money that can profitably be spent in control measures, but in some cases, and these are emphasised by the writer, greater use ought to be made of proved methods. A knowledge of the life history of a parasite is fundamental to methods of eradication or control. Several of the parasites discussed in this book afford examples of the application of such knowledge. One stage in the life history may be much less vulnerable than the others. The eggs of the sheep scab mite are unharmed by dips fatal to the mite itself. The eggs hatch in from three to seven days after deposition. Dipping a second time after seven to fourteen days allows time for the hatching of the eggs present at the time of the first dipping, but the young mites are not then old enough to lay eggs themselves. The female sheep ked deposits larvæ instead of eggs, and the larvæ pupate immediately. Inside its hard case the pupa is not destroyed by dipping. The pupal period lasts from 19 to 24 days, and the young female deposits her first larva 12 or more days after emergence, so that again the appropriate time for the second dipping is determined in the light of the life history.

The writer allows it to be apparent that one aspect of human nature has proved something of a trial to him. Economic entomology, though very fascinating, is a tantalising sphere of activity. Often enough one is unable to prescribe really practicable or effective control measures, but where advice can be given, which, if followed, would be priceless, one encounters problems in psychology. Sheep scab is a case in point. In Great Britain, says Miller, the disease is difficult to eradicate because in some parts the geographical features of the country are of such a nature that it is extremely difficult to collect all the sheep from them for the periodic dippings which are necessary to effect eradication. Sheep scab having been eradicated in Australia and New Zealand by stringent legislative measures, it is felt to be rather a reflection upon British sheep owners and those responsible for the framing and execution of live stock regulations, that sheep scab is still a serious menace in Great Britain. Miller has no doubt that scab could be absolutely eradicated if every sheep in the country could be dipped three times in three weeks, and if regulations to prevent its reintroduction from other countries were rigidly enforced. Foot-rot is another disease that is allowed to do a lot of avoidable damage. The writer points out that by a periodic run through a foot-bath of, for example, copper sulphate solution, sheep on farms notorious for the prevalence of foot-rot can be kept free from this disease to a very large extent. But too few flockmasters take advantage of this simple method. The result, in addition to loss of condition, is a great waste of the shepherd's time in catching and treating lame sheep.

Other pests that take a large toll on the shepherd's time are sheep maggot flies. In summer the time spent merely in watching a flock for indications of the irritation caused by maggots is in the aggregate considerable. These flies, which belong to three species, breed normally in the flesh of an animal that has died out in the open, but not infrequently make use of living sheep, for the

most part animals with dirty hindquarters. The various methods employed against maggot flies, as well as those directed against ticks, are not of a very radical kind. Perhaps the idea of completely avoiding attack by bluebottle and greenbottle flies is chimerical, though one is tempted to hope that knowledge of their reactions to odours or other stimuli might lead to some neat method of defence. The remarkable fact is dwelt upon by Miller that if dead or decomposing fleshy material be left lying in the open almost any time between May and early September, anywhere whatever, in town or country, it is almost certain to be used as a maggot nursery within 36 hours. A problem like this is a challenge to the wits of the entomologist.

The author has done good service in bringing together the information about sheep parasites which is made available in so convenient a form in his book. It is very useful, on the one hand, to have defined the directions in which propaganda is required, and, on the other, to have the problems indicated which call for research. Not all of these problems have been touched upon in the present review. To tackle maggot flies will be difficult, though intriguing. Treated as they have to be by flockmasters with universal respect, it would seem of pressing importance to learn everything possible about them and their ways. F. W. D.

GENERAL ITEMS AND REPORTS

Linen Industry Research Association

The sixth annual general meeting of the Linen Industry Research Association was held at Belfast on Tuesday, 23rd March, under the chairmanship of Mr. J. G. Crawford.

The report of the Council and statement of accounts were adopted on the motion of Mr. M. B. Lamb, seconded by Mr. W. H. Webb.

The retiring members of Council were re-elected on the motion of Mr. A. Scott, seconded by Mr. J. Grey.

Dr. J. Vargas Eyre, the Director, addressed the meeting, and his utterance was of a valedictory character. He was, he regretted, speaking for the last time in his official capacity as director, having accepted another engagement in Ireland. He emphasised the importance of greater knowledge of flax, the linen industry's raw material. Much had been done during the past six years in laying the foundations, evolving better methods, and in gaining experience in tackling special problems. It was now known which of the chief characteristics of the flax plants were predominantly inherited and which were mainly influenced by environment, so that future work in that connection would be conducted with greater certainty and speed. He looked optimistically forward to the future of the industry's research efforts, and unless their staple industries could be placed on a more scientific basis they would not be likely to retain supremacy. If he had been able to contribute in any way towards that condition, thanks were due largely to the members of the Association for their patience and confidence and to the staff for the soundness of their work and their studied efforts to make their institution a success.

The annual luncheon followed in the Carlton Hall, when Mr. James G. Crawford again presided over a large and influential company, the guest of honour being the Prime Minister, Sir James Craig.

The Chairman expressed gratification on account of the attendance of the Prime Minister, whose presence indicated his esteem for the Research Association. He (Mr. Crawford) proceeded to speak as to the position and progress of the work in connection with J. W. S. pedigree seed. Uniformity was one of the most outstanding characteristics of pedigree flax, and this quality would greatly minimise faults in spinning, weaving, and bleaching, and in saving waste and thereby cheapening the product. The linen industry had often been described as unprogressive, but he believed that if the institute at Lambeg was adequately supported, it was capable of furnishing the information required by the industry to place it on sound and progressive lines. Some day, he hoped, the renaissance of the linen industry would be said to date from 1919, when the Research Association was founded.

In conclusion, Mr. Crawford referred to the impending departure of Dr. Eyre, and said their only consolation was in the thought that it was the success of

Dr. Eyre's labours for the Association that marked him out for his new appointment.

Mr. H. L. M'Cready also spoke, and thanked the Imperial Government and the Northern Government for their assistance for the Association. He also joined in the expression of regret on account of the resignation of Dr. Eyre.

The Chairman, in calling upon the Prime Minister, spoke appreciatively of the assistance from the Government of Northern Ireland. The last mark of interest in and approval of the efforts to provide pedigree seed for Northern Ireland was their sanction of the purchase of de-seeding machines, which, on the basis of experiments conducted in 1925, bid fair to go a long way towards solving the question of seed saving in Ireland. He did not believe that would close the benefits derivable from the Northern Government. Finally, he pleaded for whole-hearted co-operation on the part of the Department of Agriculture and the Research Association.

Sir James Craig, Prime Minister, addressed the gathering, and said it gave him the greatest possible pleasure to meet again those who had been helping during recent trying years the industry on which he might almost say Ulster was founded. He wished Dr. Eyre every success in his new sphere of action, and also congratulated their Chairman (Mr. Crawford) upon his new honour in being appointed Consul for France. He had no doubt that the Research Association must prove of invaluable assistance to the industry by way of research in the right direction. He was convinced that, if they carried on as they had done in the past, the scientific investigation engaged in would be of enormous assistance to the industry. If there was the slightest difficulty in giving them all the financial assistance they required, it would not be owing to lack of sympathy on the part of the Government, but simply owing to safe procedure in finance and avoidance of anything that might hamper Ulster's trade in the future.

Mr. W. H. Webb proposed a vote of thanks to the Chairman and to Sir James Craig, and appealed for more widespread support for the Association.

The report of the Council falls naturally into two parts, viz., that dealing with the organisation, administration and finance of the Association, and that dealing with the research work accomplished, in hand, and in contemplation. It states that during the greater part of the financial year 1924-25, which period the report covers, the gravest anxiety was felt as to the financial position on account of the continued trade depression. To add to the anxiety the recasting of the Association's finance had to be undertaken as the end of the first quinquennial period during which a fixed arrangement with the Department of Scientific and Industrial Research had been in operation, was concluded. Protracted negotiations with the Department proved necessary before arrangements upon which the second five-year period could be commenced were made. The Council are now able to announce that satisfactory arrangements have been made which can be prosecuted successfully only if adequate co-operation and support be forthcoming from the trade. The practical issue desired is an increased membership. Of no little interest are the details given of means adopted to broaden the interest in the work of the Association, and perhaps the most valuable of these is the policy of having "open days" upon which representatives of the trade visit Lambeg and take part with increasing frequency in discussions on such topics as the production of fibre and of seed by the flax plant; further bleaching experiments; and tests for acids, chlorine, &c., in linen goods. The work of the Seed Bulking Committee is referred to, as is also the establishment of the Flax Industry Development Society, Ltd. This scheme is rightly described as "a highly important step towards securing more remunerative crops of flax both at home and in other parts of the Empire." The report then proceeds to deal with research work, and experiment work on the growth of flax is first referred to. The effect of varying the sowing conditions, of different widths between the drills, of different rates of sowing, and of using samples of seed of different germination capacities has been studied, and it is believed will prove of great value in flax cultivation generally. A seed separating machine made by Messrs. P. K. Arm, of Belfast, for the Association, has been very successful in its tests, and a large scale trial is to be given to the machine under the auspices of the Ministry of Agriculture of Northern Ireland. During the past year a sorting machine has been brought to a stage where exhaustive tests can be carried

out upon the machine, and the results have proved satisfactory. It is now being employed in a comprehensive study of the degree and character of the breakdown of flax fibre strands during preparing. Comparative records have been secured of the behaviour of yarns under a load applied and removed slowly and under the comparatively quick application and removal of loads in the loom, and so far the records show that the relative properties of the yarns determined in these two ways vary in a parallel manner. Progress has been made in the experimental investigation of a number of bleaching problems, and some of the results arrived at will shortly be published. Additional work upon sizing and finishing problems has been done, using the testing machines developed at the Institute. Altogether the report justifies the statement that the position occupied by the Association's Institute among other industrial research organisations is a high one.

Heredity in the Mule*

"I have no faith in anything short of actual measurement and the rule of three." These words of Darwin might have been taken by Porcherel as his text in attacking the problem, "How should the hereditary characters of the mule be interpreted ?" He has been concerned especially with two types of mules, those of Poitou and those of the Setif region of Algeria. He has made a very carefully planned series of measurements of mules of the different groups and of the asses and mares of the breeds used to produce them, in some cases being able to examine parents and offspring. It may be said at once that Porcherel's methods are more important than his results. Fundamental problems assuredly are involved, but the material is not favourable for their solution. One recalls how Nathusius, who made admirable studies of the coats of sheep and other mammals, examined the hairs of mules and their parents. He found that fibre structure was sometimes intermediate, but sometimes more resembled that of one parent than the other. That was before the close of the last century, while Mendel's work was still undiscovered. Nathusius thought that possibly that method might serve to bring to light principles of heredity, though he did not regard his own results as carrying him very far. Precisely because the cross is so wide one may hardly hope for convincing results in Porcherel's work. His general conclusions may be briefly quoted. It makes a great difference what breeds of asses and mares are brought together. The distribution of paternal and maternal characters in the hybrids shows very great variability. Characters intermediate between those of the two parents are always more in evidence than those received from the ass. In the Poitou mules the characters received from the mares predominate, sometimes in a very evident manner; the same is true in some cases with Algerian mules. It is emphasised that the greatest care should be taken in choosing the mare for mule production. Porcherel is under the disadvantage of having to deal with a cross between species, while within each breed of horse or ass he found a large amount of variation. Furthermore, he is concerned with characters of a kind the inheritance of which is very difficult to interpret, even when the geneticist is able to choose the most convenient material. Thus, in the rabbit, Castle has obtained data by crossing large and small breeds, which he would explain by postulating as many as ten Mendelian factors. Whether the size of a particular part of a rabbit is determined chiefly by factors affecting the general size of the body, or mainly by factors that produce their effect upon that special part, is a subject upon which there is disagreement. In deermice, after prolonged studies of the genetics of the size of parts of the body, Sumner even doubts whether his results are to be explained purely on Mendelian lines. With the mule there is yet another complication. In plants wide crosses often produce remarkably vigorous offspring. Opinions differ about the significance of this, but the fact itself is well known. The mule is the stock example of the same thing in animals. Although sterile, it is hardier than the horse and does more work on less food. Incidentally it may be mentioned that a similar effect may be one of the advantages of crossing certain breeds of sheep. The facts which have just been touched upon cause a student of heredity, even though desirous of producing results in the workaday

* Porcherel, E.—*International Review of the Science and Practice of Agriculture*, New Series, 1925, **3**, No. 4, pp. 982-1002.

world, to wonder how he can most usefully spend his time. At the present stage of our knowledge of heredity, if economic work be undertaken, less complicated problems than that tackled by Porcherel should be selected. It would appear from Porcherel's paper that he is not very conversant with modern work in genetics, but it is clear that he has an eye for the form of an equine which commands the respect of one mainly concerned with microscopic characters in small animals. He is Director of Zootechnical Research in the National Veterinary School at Lyons. He has worked out a very thorough scheme of measurements of parts, and of indices to show the comparative size of parts. For example, the thoracic index is expressed by the relation between the greatest width of this region and the height; the dactylo-thoracic index is the relation between the perimeter of the skin and that of the thorax. Similar methods might well be employed in the study of problems of inheritance in sheep or other domestic animals. In work on crosses between breeds, or on the inheritance of structural characters within a breed, he might hope for more definite results. A worker in pure genetics is not likely to have Porcherel's intimate knowledge, combined with appreciation of form, of such an animal as the horse, nor is it probable that a practical breeder, equally qualified in those respects, would be capable of expressing the characteristics of different animals in terms of series of comparable measurements and ratios —F. W. D.

Dyestuffs (Import Regulation) Act 1920—Application for Licenses

The following statement relating to applications for licenses under the Dyestuffs (Import Regulation) Act 1920, made during the first three months of this year, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during January was 581, of which 509 were from merchants or importers. To these should be added 24 cases outstanding on the 31st December, making a total for the month of 605. These were dealt with as follows—

Granted, 475; referred to British makers of similar products, 96; referred to reparation supplies available, 16 ; outstanding on 30th January 1926, 18.

The total number of applications received during February was 549, of which 476 were from merchants or importers. To these should be added 18 cases outstanding on the 30th January, making a total for the month of 567. These were dealt with as follows—

Granted, 475; referred to British makers of similar products, 65; referred to reparation supplies available, 7; outstanding on 27th February 1926, 20.

The total number of applications received during March was 592, of which 515 were from merchants or importers. To these should be added 20 cases outstanding on the 27th February, making a total for the month of 612. These were dealt with as follows—

Granted, 516; referred to British makers of similar products, 60; referred to reparation supplies available, 11; outstanding on 31st March 1926, 25.

Of the total of 1,794 applications received, 1,589, or 88 per cent., were dealt with within seven days of receipt.

THE JOURNAL OF THE TEXTILE INSTITUTE

Vol. XVII MAY 1926 No. 5

PROCEEDINGS

SIXTEENTH ANNUAL GENERAL MEETING, AT MANCHESTER, 21st APRIL 1926

This meeting took place as stated at the Institute premises, Manchester. At the outset the chair was occupied by the retiring President, Mr. John Emsley, J.P., who was supported by the President-elect (Mr. Wm. Howarth, J.P.), Col. F. R. McConnel, W. Frost, T. Fletcher Robinson and others, there being an attendance of over thirty members.

It was unanimously agreed that minutes of previous annual meeting, as circulated at the meeting, be taken as read and approved.

THE ANNUAL REPORT OF THE COUNCIL

Mr. S. B. Hollings (Bradford) moved, and Mr. W. Heaps (Bolton) seconded, that this report, as circulated, be adopted, and the motion was carried unanimously.

The report, together with balance sheet and accounts (1925), was as follows—

Although the progress of the movement represented by the Textile Institute has not been rapid, yet a steady rate of advancement, since its formation in 1910, has been maintained. The past year provided an unprecedented record of attainment in several directions. Of paramount importance is the reconstruction of the organisation under the terms and provisions of a Royal Charter of Incorporation, granted by His Majesty's Privy Council in March 1925. The decision to embark upon an effort in this direction was not arrived at without prolonged and anxious consideration, and the fact was not overlooked that the advantages to accrue therefrom must be associated with greatly increased responsibilities. It was always contemplated by the promoters, and the early supporters, of the Institute movement, that in addition to the provision of a definite platform for the consideration of scientific and technical problems, together with publication facilities, some form of certification of qualification should be available in connection with membership. Not until 1922, after the election of Mr. John Emsley, J.P., of Bradford, to the position of President, was any practical step taken in the matter. Mr. Emsley early sought means to contribute something of lasting benefit, and, having once decided in favour of supporting an endeavour to secure a Royal Charter empowering the Institute to grant diplomas in reference to "the practice, teaching, or profession of textile technology," spared neither time nor generosity in seeing the project carried through, kindly accepting office for four consecutive years for this purpose. Recognition has been already extended to the President in respect of his services and generous action in meeting the entire cost of the application for the Institute's Charter, as well as other incidental expenses, but the Council cannot permit the issue of this record without expressing warmest appreciation of the President's successful endeavour.

INSTITUTE DIPLOMAS—The Institute is now constituted an examining body concerned with certification of post-graduate qualifications for members by the issue of Diplomas of Associateship and Fellowship. Applications have come forward in considerable number, and the first awards will be announced at the Annual General Meeting. The Selection (Diplomas) Committee has a task which is by far the most exacting yet imposed on any Institute Committee.

Whilst certain more or less definite decisions as to procedure have been reached, yet the Committee is proceeding cautiously in the matter of precise regulations, preferring to rely upon the actual terms of the Bye-laws and to build up subsidiary regulations as experience in dealing with early applications may dictate. For the present, at any rate, all possible consideration is being given to possession by applicants of qualifications by well-established examining authorities, always provided that the claims of applicants in respect to engagement subsequent to training or graduation can be regarded as satisfactory. Already, special examination in general knowledge as to textile technology has been imposed in reference to a number of applications. The Committee is encouraged by the fact that this condition has been readily accepted by the majority of applicants affected.

ANNUAL CONFERENCES—Two general conferences were held in the past year—the one in connection with the Annual General Meeting at Manchester, in April, and the other at Edinburgh. This was the second time at which the annual movable conference has taken place in Scotland, and although the attendance was not quite up to the average, yet it was satisfactory and the event was highly successful. The Lord Provost of Edinburgh gave a reception to the members and visitors at the outset of the proceedings, whilst the concluding item of the visit took the form of excursions to Galashiels and Dunfermline respectively. Excellent arrangements were made at each place and various works were inspected. Those concerned with the arrangements and with the hospitality provided have already been warmly thanked for their generous co-operation. The conference at Edinburgh was held during Whit-week, and in view of the experience that this is a highly favourable time of year for the holding of such an event, the 1926 conference was to have taken place during Whit-week at Buxton, but in view of the industrial situation was cancelled.

JOURNAL OF THE INSTITUTE—It was pointed out in the Council Report of 1924 that to maintain the magnitude of the *Journal* during 1925 at the point reached the year before would present a serious financial problem. To aid in achieving, as far as possible, this desired result, it was decided to prepare, firstly, an estimate of expenditure and income, and, secondly, a quarterly statement of actual income and expenditure, so that progress could be controlled. The Council had asked that a sum £350 less than the expenditure for 1924 should be regarded as a maximum expenditure for 1925, and the estimate referred to above was based upon this request. While the Proceedings and Transactions Sections of the *Journal* were both less than the same Sections in 1924, the Abstracts Section, which provides a service of increasing value, exceeded any previous year. At the same time, by attention to every aspect of expenditure, and by a very welcome addition to the income of £100 from the Linen Industry Research Association, which made no grant in the previous year, it was ultimately found possible to produce the *Journal* during 1925 for an expenditure of £556 less than for 1924. The Research Associations have given continued support not only by financial assistance, but by valuable services on the Publications Committee—without this aid the work would suffer appreciably.

INSTITUTE HEADQUARTERS AND OTHER OFFICES—The headquarters premises of the Institute at Manchester are becoming a centre of growing activity and the Council continues to extend facilities for meetings to various organisations concerned directly or indirectly with the textile industry. The Members' Room at the Institute is visited by members with increasing frequency and facilities for refreshments are now fairly well established. In connection with the London offices and rooms, at 38 Bloomsbury Square, W.C.1, the suggestion which has frequently arisen in favour of some scheme of joint accommodation has taken definite shape during the past year. In addition to the Institute, with its particular accommodation for the London Section, the premises are utilised, under joint arrangement, by the Association of Special Libraries and Information Bureaux. For 1926, also, some accommodation is also provided for the British Institute of Industrial Art. The full effect of these arrangements will be better known by the end of 1926, but it is now certain that advantages will arise and the expenditure of the London offices and rooms will be considerably reduced, so far as the Institute is concerned. The Council desires to record its great appreciation of the earnest endeavours of the London Section Committee in the direction of the ultimate attainment of self-supporting conditions in regard to purely Section affairs. In connection with the Yorkshire Section of the Institute,

too, an arrangement has been made whereby the services of an Assistant Secretary, with his own office address (Mr. F. R. Thurlow, Sykes' Chambers, 37a Ivegate, Bradford), have been secured.

DESIGN AND STRUCTURE OF FABRICS—The Annual Competitions for advanced textile students at technical colleges, schools, &c., under the Institute's Crompton Scheme, has proceeded satisfactorily, and the work presented by the 1925 competitors was regarded as distinctly progressive. A total sum of £110 was distributed in prizes, and for the first time a special award of £10 was made in respect of the production of a single specimen of cloth of original and novel texture. It is interesting to note that the first prize (£35) in the general competition was awarded to a student-competitor from the Bradford Technical College. For 1926, the Institute range of prizes is extended by the addition of special competitions for yarns. Messrs. R. Greg & Co. Ltd. (South Reddish, Stockport), have generously agreed to contribute £25 per annum for three years in order that prizes may be offered for competition in yarns, the object being to encourage students in the spinning departments of technical colleges and schools. The scheme is experimental and the results will be watched with interest.

TEXTILE SOCIETIES AND KINDRED ORGANISATIONS—The Institute continues to provide facilities and secretarial services for occasional conferences of representatives of Textile Societies and Kindred Organisations in the various textile areas. Two conferences of delegates were held during the year—in February and October—and it is felt that a good deal of useful service is performed in this connection. The meetings have been proved of considerable benefit to all concerned, and it is believed that there is a distinct field for mutual co-operation on various matters.

FOUNDATION FUND—This fund continues to expand even though the rate of progress of building up a fund of the strength originally aimed at is somewhat slow. The total amount to the credit of the fund, as shown in the balance sheet, is £9,853 7s. invested in War Stocks, whilst £25 in cash remained at the bank. In addition to these amounts, there is £1,000 of War Stock and £1,500 of 4% L.M. & S. Railway Preference Stock, which refer to the Crompton Prize Fund Scheme. Taking the Crompton contribution at the nominal figure of £2,000, the total of the Foundation Fund at the end of the year reached £11,878 7s. The actual new contributions during 1925 were—£500 from Messrs. Courtaulds, Ltd., and a contribution of £25 from Mr. E. A. Swift, of Bradford. A further donation has been received, in 1926, of £83 4s. 7d. from the Cotton Textile Industry Committee (Wembley Exhibition).

COUNCIL AND COMMITTEE MEETINGS—The following is the record of meetings held during the year (1st January to 31st December 1925)—Council, 12; Selection (Diplomas), 13; Publications Committee, 11; Propaganda, 9; Finance, 6; Yorkshire Section, 8; London Section, 11; Lancashire Section, 1; Crompton Prize Fund, 4; Total, 76; as against 48 in the previous year. In addition to the foregoing, two Sub-Committees met for the consideration of special matters.

SECTION MEETINGS AND LECTURES—Seven meetings of the Lancashire Section and one joint meeting, two of the Yorkshire Section and one joint meeting, and 10 of the London Section were held during 1925, at which papers were read and discussed.

MEMBERSHIP—The membership list at the end of 1925—to be carried forward to 1926—was made up as follows—Honorary Members, 9; Life Members, 21; Members, 1,179; Junior Members, 64; Non-subscribing Members, 2; Total, 1,275.

The totals for the foundation year (1910) and the years 1918 to 1925 were—1910, 233; 1918, 612; 1919, 724; 1920, 856; 1921, 904; 1922, 994; 1923, 1,039; 1924, 1,083.

The Council lament the loss by death during the past year of Thomas Smith (Accrington); William Myers (Manchester); William Greenwood (Oldham); Robert M'Keown (Belfast); Peter Scott (Hawick); C. Greenwood (Huddersfield); George E. Mallott (Preston); E. H. Gates (Bradford); J. L. Lumsden (Freuchie, Fife); J. L. Smith (Huddersfield); James Marsden (Bolton); J. Pogson (Lytham).

Dr. The Textile Institute—Balance Sheet

1924 £	s.	d.	LIABILITIES	£	s.	d.	£	s.	d.
69	6	0	Subscriptions paid in advance				264	12	0
			Life Membership Subscriptions Account—						
			Balance as at 31st Dec. 1924	29	11	10			
			Subscriptions received during year ...	63	0	0			
				92	11	10			
			Less Amount transferred to Revenue Account (10% on £487 0s. 0d.)	48	14	0			
69	11	10					43	17	10
9352	6	0	Foundation Fund				9878	7	0
2500	0	0	Crompton Prize Fund				2500	0	0
47	10	0	Perpetual Membership Special Reserve Account				97	10	0
113	10	0	Crompton Prize Fund Scheme—Income and Expenditure Account Balance				146	16	10
250	0	0	*Journal* Account—Reserve to 1926, Subscriptions received for period unexpired ...				150	0	0
603	18	7	Sundry Creditors, as per list				295	10	11
			Revenue Account—						
			Surplus for year to 31st Dec. 1925 as per Revenue Account	132	19	11			
			Less Debit Balance at 31st Dec. 1924	64	14	7			
				68	5	4			
			Less Adjustment of Life Membership Subscription Account	10	0	0			
							58	5	4
£13006	2	5					£13434	19	11

T. FLETCHER ROBINSON, *Hon. Treasurer.*
J. CROMPTON, *Chairman of Council.*

as at 31st December 1925 Cr.

1924 £ s. d.	ASSETS	£ s. d.	£ s. d.
	Cash at Bank—		
40 4 5	General Account	27 10 2	
	Foundation Fund Account	25 0 0	
			52 10 2
7 17 7	Cash in hand		5 12 11
	Sundry Debtors—		
343 14 9	*Journal* Account—Outstanding Advts. ...	319 12 3	
128 6 10	Outstanding Reprints and Subscriptions...	65 8 0	
—	Reserve for Printing &c.	23 18 4	
15 0 0	Hire of Rooms	11 9 6	
			420 8 1
	Furniture, Fittings and Library Account—		
	Balance as at 31st Dec. 1924	303 11 4	
	Additions during the year	120 18 0	
		424 9 4	
	Less Depreciation, 12½% on £424 9s. 4d.	53 1 2	
303 11 4			371 8 2
	London Section Furniture and Equipment Account—		
	Balance as at 31st Dec. 1924	149 6 11	
	Less Depreciation, 12½% on £149 6s. 11d.	18 13 4	
149 6 11			130 13 7
3 10 0	Deposit on Electricity		3 10 0
	Perpetual Membership Capital Investment Account—		
97 10 0	£99 1s. 6d. 5% War Stock, 1929–47, at cost		97 10 0
	Crompton Prize Fund Capital Investment Account—		
	£1000 5% War Stock, 1929–47 ...	1000 0 0	
	*£1125 4% L. M. & S. Rly. Preference Stock	1500 0 0	
2500 0 0			2500 0 0
	Foundation Fund Capital Investment Account—		
	£3737 14s. 9d. 5% War Stock, 1929–47, at cost	3503 7 0	
	£1000 0s. 0d. 5% National War Bonds, 1927	1000 0 0	
	£4550 0s. 0d. 5% National War Bonds, 1928	4550 0 0	
	£1000 0s. 0d. 4% Funding Loan, 1960–1990	800 0 0	
9352 6 0			9853 7 0
	Revenue Account—		
64 14 7	Debit balance 31st December, 1924 ...		—
£13006 2 5			£13434 19 11

*As originally standing at date of gift and subject to present Market Values.

AUDITORS' REPORT TO MEMBERS

We report to the members that we have examined the above Balance Sheet together with the books and vouchers of the Institute and that we have obtained all the information and explanations we have required.

We further report that in our opinion the Balance Sheet is properly drawn up so as to exhibit a true and correct view of the Institute's affairs according to the best of our information and the explanations given to us, and as shown by the books of the Institute.

25*th January* 1926. (*Signed*) ARTHUR E. PIGGOTT, SON & CO.
56 Mosley St., Manchester. *Incorporated Accountants, Auditors*

Dr. The Textile Institute—Revenue Account

1924 £	s.	d.	EXPENDITURE	£	s.	d.	£	s.	d.
139	12	8	To Rent and Rates	213	9	4			
			Less Proportion to *Journal*	71	3	1			
							142	6	3
			,, Secretarial and Editorial Remuneration...	1000	0	0			
			Less Editor's Salary, £450, and General Secretary's Contributions to *Journal*, £60	510	0	0			
490	0	0					490	0	0
			,, Office Wages (*less* £25 Ring Yarn Assn.) ...	363	5	0			
			Less Proportion to *Journal* A/c. ...	128	5	0			
201	5	0					235	0	0
			,, Office Expenses — Heating, Lighting, and Cleaning	79	19	4			
			Less Proportion to *Journal* A/c. ...	26	13	1			
89	8	2					53	6	3
82	3	6	,, Sundries—Rooms, Canteen, Attendant, Utensils				71	11	5
23	12	3	,, Travelling Expenses	18	8	10			
25	2	0	,, Meetings (including Travelling) Expenses	51	18	1			
							70	6	11
70	7	0	,, Postages, Telegrams, and Telephones ...				99	8	6
80	3	2	,, Printing and Stationery				152	5	0
5	18	9	,, Insurances				5	10	1
15	18	8	,, Audit and Accountancy Charges				15	17	0
			,, Subscriptions—						
1	1	0	Institute of Psychology	1	1	0			
2	2	0	British Institute of Industrial Art ...	2	2	0			
							3	3	0
43	7	4	,, Depreciation on Furniture &c.—Manchester	53	1	2			
22	5	1	,, ,, ,, ,, London ...	18	13	4			
							71	14	6
588	16	2	,, Sections' Expenses—London	497	16	4			
38	19	11	Lancashire	33	13	9			
7	4	4	Yorkshire	10	6	5			
							541	16	6
			,, Bank Charges *less* Interest				6	9	0
			,, Charter: Legal Expenses, &c.	650	0	0			
			Less Donation by President, John Emsley, Esq....	650	0	0			
7	15	0					—		
			,, Charter Celebration Dinner—Balance ...				1	11	0
194	13	10	,, Empire Textile Conference—Expenditure over Receipts				56	17	5
			,, Painting and Decorating				3	0	0
507	15	2	,, Deficit on *Journal* A/c. £123 3s. 5d., see Account						
2637	11	0					2020	2	10
			,, Excess Income over Expenditure ...				132	19	11
£2637	11	0					£2153	2	9

T. FLETCHER ROBINSON, *Hon. Treasurer.*
J. CROMPTON, *Chairman of Council.*

for the Year ended 31st December 1925 Cr.

1924 £ s. d.	INCOME	£ s. d.	£ s. d.
	By *Membership Subscriptions*—		
	Life Membership Subscriptions ...	48 14 0	
	Subscriptions (1925 Account) paid in advance per Balance Sheet, 31/12/24	69 6 0	
	,, *Membership Subscriptions*—		
	994 Members at £2 2s.	2087 8 0	
	46 Members at £1 1s. (half year) ...	48 6 0	
	58 Juniors at £1 1s.	60 18 0	
	7 Juniors at 10s. 6d. (half year) ...	3 13 6	
		2318 5 6	
	Arrears paid during 1925 (see Balance Sheet for Subscriptions paid in advance)	40 0 8	
	Dividend on £100 5% War Loan ...	5 0 0	
		2363 6 2	
	Less 25% to *Journal* Account ...	590 10 8	
		1772 9 6	
	Annual Subs.: The Weavers' Co. ...	21 0 0	
1704 13 9			1793 9 6

TOTAL ARREARS at 31st Dec. 1925	£105 0 0
ARREARS WRITTEN OFF ...	69 6 0
Total Arrears Current	£35 14 0

1924 £ s. d.		£ s. d.
2 2 4	,, Bank Interest, *less* Charges	—
20 0 0	,, Administration Expenses in connection with Crompton Prize Fund Scheme ...	20 0 0
279 8 8	,, Transfer from Foundation Fund Income from Investments Account	339 13 3
631 6 3	,, Excess Expenditure Over Income ...	—
£2637 11 0		£2153 2 9

Audited and found correct,

25th January, 1926. ARTHUR E. PIGGOTT, SON & CO.

56 Mosley St., Manchester. *Incorporated Accountants. Auditors.*

Dr. The Textile Institute—Journal Account

1924 £	s.	d.	EXPENDITURE	£	s.	d.	£	s.	d.
291	5	7	To Outstanding Advertisement and Reprints Accounts, brought down				472	1	7
2522	13	8	,, Printing, Posting and Reprints				2147	1	10
113	2	11	,, Literary Contributions	36	9	10			
28	19	4	,, Abstracts ,, ...	17	12	9			
							54	2	7
400	0	0	,, Editorial Remuneration	450	0	0			
60	0	0	,, Secretary's contributions	60	0	0			
							510	0	0
96	15	0	,, Wages, Clerical and Advertising (*less* £25 Ring Yarn Association)...				103	5	0
23	19	3	,, Postages and Telegrams				21	12	10
0	19	3	,, Stationery				20	2	4
9	12	0	,, Binding				5	1	0
26	17	10	,, Purchase of *Journals* and general expenses				9	1	9
11	19	5	,, Travelling Expenses				31	4	5
69	16	4	,, Rent and Rates (proportion)				71	3	1
			,, Heating, Lighting, and Cleaning (proportion)				26	13	1
43	1	3	,, Advertisement Commission				51	3	3
250	0	0	,, Reserve—Subscriptions from Cotton Research Association carried down ...				150	0	0
230	13	10	,, Sundry Creditors for Printing &c., carried down				293	11	3
£4179	15	8					£3966	4	0
343	14	9	To Outstanding Advertisement Accounts, brought down				319	12	3
128	6	10	,, Outstanding Accounts for Reprints and Subscriptions brought down				65	8	0

T. FLETCHER ROBINSON, *Hon. Treasurer.*
J. CROMPTON, *Chairman of Council.*

for the Year ended 31st December 1925 Cr.

1924 £ s. d.	INCOME	£ s. d.	£ s. d.
200 0 0	By Reserve—Subscriptions from Research Associations brought down		250 0 0
	,, Outstanding Accounts for Printing brought down		230 13 10
	,, Subscriptions—		
10 10 0	Clothworkers' Company		10 10 0
	Cotton Research Association	300 0 0	
	Woollen and Worsted Institute ...	150 0 0	
600 0 0			450 0 0
	,, Donations—		1 8 6
1101 6 8	,, Advertisements and Subscriptions ...	1434 17 1	
522 12 4	,, Reprints Account	489 14 3	
			1924 11 4
4 5 4	,, Sundry Receipts		
343 14 9	,, Outstanding Advertisement Accounts, carried down		319 12 3
128 6 10	,, Outstanding Accounts for Reprints and Subscriptions, carried down		65 8 0
£2910 15 11			£3252 3 11
561 4 7	,, Transfer of 25% Total Members' Subscriptions		590 16 8
507 15 2	,, *Balance*—Deficit £123 3 5		
	,, Transfer from Foundation Fund Income from Investments Account to meet the		
200 0 0	above Deficit		123 3 5

JOURNAL EXPENDITURE	£3966 4 0
JOURNAL INCOME ...	£3252 2 11
Deficit on Working Account	£714 0 1

£4179 15 8		£3966 4 0

250 0 0	By Reserve—Cotton Research Association, brought down	150 0 0
230 13 10	,, Sundry Creditors for Printing &c., brought down	293 11 3

Audited and found correct,

25*th January* 1926. ARTHUR E. PIGGOTT SON & CO.

56 Mosley St., Manchester. *Incorporated Accountants, Auditors.*

The Textile Institute—Crompton Prize Fund for the Year ended

Dr.

1924 £	s.	d.	EXPENDITURE	£	s.	d.
27	5	0	To Printing and Stationery	26	10	9
54	19	5	,, Purchase of Specimens	23	12	2
8	0	0	,, Mounting of Specimens	8	0	0
	13	6	,, Binding Albums		—	
2	15	7	,, Postages, Carriage &c.	2	9	9
107	5	5	,, Prize Awards and Expenses	116	4	6
20	0	0	,, Administration Expenses	20	0	0
220	18	11		196	17	2
113	10	0	,, Balance carried down	146	16	10
£334	8	11		£343	14	0

The Textile Institute—Foundation Fund for the Year ended

Dr.

1925	EXPENDITURE	£	s.	d.
June 8th.	To Mather Lecture	25	0	0
Dec. 31st.	,, Transfer to *Journal* Account to meet deficit for the year	123	3	5
	,, Balance transferred to Revenue Account	339	13	3
		£487	16	8

T. FLETCHER ROBINSON, *Hon. Treasurer.*
J. CROMPTON, *Chairman of Council.*

Income and Expenditure Account 31st December 1925 — Cr.

1924 £ s. d.	INCOME	£ s. d.	£ s. d.
66 1 0	By Balance brought forward		113 10 0
166 3 0	,, Albums Subscriptions		130 13 0
1 18 0	,, Competition Entrance Fees		4 11 0
50 0 0	,, Dividend on £1000 War Stock	50 0 0	
34 17 6	,, Dividend on £1500 L.M. & S. Rly. Stock	35 3 1	
			85 3 1
15 9 5	,, Refund of Income Tax		9 16 11
£334 8 11			£343 14 0
113 10 0	By Balance brought down		146 16 10

Income from Investments Account 31st December 1925 — Cr.

1925	INCOME	£ s. d.
March 1—By	Dividend—5% War Bonds	113 15 0
May 1— ,,	,, 4% Funding Loan	15 10 0
June 1— ,,	,, 5% War Stock	7 10 0
,, 1— ,,	,, 5% War Stock	3 8 4
,, 1— ,,	,, 5% War Loan	85 0 0
,, 1— ,,	,, 5% War Loan	10 0 0
Sept. 1— ,,	,, 5% War Bonds	113 15 0
Nov. 1— ,,	,, 4% Funding Loan	16 0 0
Dec. 1— ,,	,, 5% War Stock	7 10 0
,, 1— ,,	,, 5% War Stock	3 8 4
,, 1— ,,	,, 5% War Loan	85 0 0
,, 1— ,,	,, 5% War Loan	10 0 0
,, 1— ,,	,, 5% War Stock	12 10 0
,, 31— ,,	Refund of Income Tax (Funding Loan)	4 10 0
		£487 16 8

Audited and found correct,

25th January 1926. ARTHUR E. PIGGOTT, SON & CO.

56 Mosley St., Manchester. *Incorporated Accountants, Auditors.*

THE HON. TREASURER'S ANNUAL REPORT

The Hon. Treasurer (Mr. T. Fletcher Robinson) presented his annual report as follows—

In presenting my twelfth annual report, I have continued comparison of items as in previous years in order that members may easily make examination of the accounts.

FOUNDATION FUND—There has been an increase of £501 1s. during the year, £500 of which represents a generous donation from Messrs. Courtaulds, Limited, the total of the fund being £9,853 7s. on 31st December 1925. There has been received since, £25 from Mr. E. A. Swift, of Bradford, and £83 4s. 7d. from the Cotton Textile Industry Committee (Wembley). For all these donations the thanks of the Council have been tendered.

JOURNAL ACCOUNT—The expenditure is £3,816 4s., being £213 11s. 8d. less than 1924, the income being £3,102 3s. 11d., leaving a deficit on working account of £714 0s. 1d., which is £554 19s. 8d. less than 1924. Twenty-five per cent. of the total members' subscriptions, £590 16s. 8d., and a transfer from the Foundation Fund interest of £123 3s. 5d., balances the Journal account.

Grants were received from Research Associations—Cotton, £300; Wool, £150; Linen, £100; total £550.

The receipts from advertisements and subscribers were £1,434 17s. 1d., being £333 10s. 5d. more than 1924. There was an increase under this head in 1924 of £265 3s. 8d., making an increase in the last two years of £598 14s. 1d.

The cost of printing the *Journal*, and postage and reprints, was £2,147 1s. 10d., being £375 11s. 10d. less than 1924. An increase of £50 in the Editor's salary makes the cost under this head, with secretarial contributions debited as £60, into £510, as against £460. Wages (clerical and advertising) are £6 11s. more, and there has been an additional cost for stationery of £19 3s. 1d.

The cost of purchase of *Journals* and general expenses is £17 16s. 1d. less, whilst travelling expenses are £19 5s. more.

Literary contributions and abstracts, together, have cost £87 19s. 8d. less.

This year the sum of £26 13s. 1d. has been debited to *Journal* Account as a proportion for heating, lighting, and cleaning. Advertisement canvassing commission has cost £51 3s. 3d., being £8 2s. more.

There is no prospect that the expenditure on the *Journal* will be any less in 1926; on the contrary, there will be considerably more expense, because there will be many more papers to be published consequent upon the contributions from applicants for Institute Diplomas, besides anticipated increase of original matter from Research Associations.

REVENUE ACCOUNT—The cost of obtaining the Royal Charter was £650, which amount has been paid by our President, Mr. Emsley, to whom the Council has expressed special appreciation. The income from members' subscriptions is £2,384 6s. 2d., from 1,105 members, being £118 7s. 10d. more than in 1924 from 960 members. Salaries and wages on revenue account are £725, being £33 15s. more than in 1924. Travelling and meetings cost £70 6s. 11d., an increase of £21 12s. 8d. on 1924. Printing, stationery, postages, and telegrams cost £251 13s. 6d., being £101 3s. 4d. more than the previous year.

London Section expenses have been £497 16s. 4d., being £90 19s. 10d. less, the members in the London Section numbering 193, as against 142. The contribution from the Special Libraries Bureaux for joint use of the rooms for seven months has reduced the expense by £77 7s. 10d. For 1926 an arrangement has been made with the Institute of Industrial Art, from whom there will be a further income. For the full year 1926, from these two organisations, we expect to receive about £175.

The interest from the Foundation Fund, £487 16s. 8d., has been transferred as follows—to Revenue A/c £339 13s. 3d.; Journal A/c £123 3s. 5d.; and for the Mather Lecture £25.

The definite income for 1925 is £2,384 6s. 2d., and interest from Foundation Fund £487 16s. 8d., making a total of £2,872 2s. 10d., being £126 15s. 10d. more than 1924.

Receipts from members' subscriptions have been—1917, £851 2s. 6d.; 1919, £1,394 5s. 5d.; 1922, £1,694 14s.; 1923, £2,136 13s. 6d.; 1924, £2,265 18s. 4d.; 1925, £2,384 6s. 2d.

Membership at 31st December 1925, was 1,275, being an increase of 192 members on the year. The expenditure for rent, rates, heating, lighting, and cleaning compares as follows—1918, £219 3s. 11d.; 1920, £221 9s. 5d.; 1922, £300 19s. 5d.; 1923, £271 7s. 9d.; 1924, £298 7s. 2d.; 1925, £293 8s. 8d. The cost of salaries and wages of staff (including *Journal*) has been—1918, £453 12s. 6d.; 1920, £1,144; 1922, £1,465 5s.; 1924, £1,248; 1925, £1,363 5s.

SUMMARY—After meeting from the Foundation Fund interest the deficit on the *Journal* of £123 3s. 5d., and the deficit on Revenue A/c of £339 13s. 3d. there remains a balance to credit of Revenue A/c of £132 19s. 11d. to be carried forward to 1926.

CROMPTON MEMORIAL FUND—The income from invested funds has been £94, and from subscriptions from education authorities for Albums £130 13s., this latter being £35 10s. less than for the previous year. The balance in hand on 31st December last is £146 16s. 10d.

DIPLOMAS—There have been already 123 applicants for Fellowships and 183 for Associateships, and £600 for fees has been received up to date. The problem of how the money from Fellowship fees should be allocated is receiving the serious attention of the Council.

The financial situation at the end of 1925 is much better than at end 1924, and with careful management of the finances, and additional membership, due to increased interest as a result of the securing of the Royal Charter, the Institute should make a quick advance to greater usefulness and success.

The Hon. Treasurer also formally presented the balance sheet and accounts, as printed and certified by the Auditors, and moved that the Hon. Treasurer's report and the balance sheet and accounts be approved.

Mr. John Crompton seconded the motion, which was carried unanimously.

PRESENTATION OF DIPLOMA TO MR. J. H. LESTER

Mr. John Emsley, as the retiring President, stated that he had a very pleasant duty to perform before he relinquished office, namely, to present to Mr. J. H. Lester the Fellowship Diploma of the Institute. It was regrettable that illness prevented Mr. Lester from being present and receiving the Diploma personally. He was quite sure that all would agree with him in stating that Mr. Lester had rendered services to the Institute for which money would not have been adequate recompense. It was to be sincerely hoped that he would soon be restored to his normal state of good health and strength.

The Diploma, contained in a handsome leather wallet bearing a suitable inscription, was handed to the General Secretary (Mr. J. D. Athey) for transmission to Mr. Lester.

VOTE OF THANKS TO RETIRING PRESIDENT

Mr. John Crompton (Chairman of Council) proposed that a very hearty vote of thanks be accorded the retiring President, Mr. John Emsley, for the valuable services he had rendered during his term of office. It had been quite an education to be associated with Mr. Emsley, and his colleagues fully appreciated the good spirit and thoroughness with which he had undertaken his duties. Mr. Emsley's years of office had been prolonged owing to the delay in obtaining the Charter, and, of course, he could not be possibly released from his responsibilities until it was secured. It was probable that future generations would best be able to realise the value of that Charter, which, doubtless, ought to have been obtained many years previously. It was certain that it would be a fruitful means of contributing to the welfare of the textile industry, and it was largely owing to the vision of Mr. Emsley and his persistence and generosity that the Institute could now confer its Diplomas upon those who were deemed worthy to receive them. Mr. Emsley was one of the leaders of the textile industry whom they delighted to honour, and it was most certainly a proud moment for him when, some months ago at Bradford, he was presented with the first Fellowship of the Institute in the interests of which he had laboured so long and so conscientiously.

Mr. W. Frost (Vice-President) seconded, and said that when Mr. Emsley first came to them they knew very little about him. All that was known was

that he was a Yorkshireman, with all that the name implied, and that he was going to do the very best he could for the welfare of the Institute. The two things which were most impressive in connection with the work he had done, and which demonstrated the possession of certain fine qualities of character, were his optimism and his pertinacity in carrying forward anything he undertook. He had left his mark upon the work of the Institute, and had made it possible for it to fill a much wider field of services in years to come.

The motion was carried by acclamation.

Mr. Emsley, responding, said—Mr. Crompton, Mr. Frost and gentlemen, I have listened with very mixed feelings to the remarks which have been made about myself. I think, and I have always said, that anybody who has been in a position to get anything out of an industry should not think that he is entitled to it all, but that he should give something back to the industry. The textile industry, next to agriculture, is the greatest industry in this country. It is the industry that finds the bulk of our food, as 44 per cent. of the total of the goods that are exported are textiles. That means that the textile industry must shoulder a great responsibility, and that it must not, and shall not so long as the Textile Institute remains, take second place to any other section of the community. I have been very much impressed during my years of office with the fact that we have no salvation for this country except through science. The days of machinery were very great in this country, but machinery has played its part. Machinery, in my opinion, now takes a secondary place, and science will take the first place in industry. You may think that the industry has not taken up research work in the way that perhaps originally was intended, but its various branches have been forced to undertake such work and are making good progress. The Textile Institute, as the head authority, is able to co-ordinate all the various branches of the industry, and by the aid of our Charter we have lifted our industry from the position of a trade to the status of a profession. I hope that the country will realise that there are opportunities in the industry for its cleverest men. It is no longer necessary for a man to go into law, divinity, or politics. He can come now into a professional trade, and can do quite as much good, or even more good, through trade, than in other directions. The textile industry is a very complicated one. We have to live by our exports. We cannot grow sufficient food in this country to keep us, and we have to pay for the food which we receive from foreign countries by our industry; otherwise, we cannot keep our population in a reasonable state of prosperity. I look forward to the time when it will be no longer hard work for people to earn their daily bread. I believe that science will help to make the machine subservient to the human element to such a degree that the physical body shall not have to exert itself as much as it has exerted itself hitherto. but that the brain will take a bigger part in the affairs of life than ever it has taken before. I have always thought I would like to see the person who has to do the manual labour have a reasonable amount of time for instruction, for recreation, and for leisure, and for all the things that make life worth living. But what is the use of having that extra time and those added amenities unless our bodies are physically able to stand the strain of our work and also of our recreation ? I want to cut out as much physical labour as I can from our daily task and make it a pleasure, and therefore make our recreation, after we have done our physical toil during the day, a pleasure also. I believe that science will make this a wonderful world to live in. There was one gentleman in England who made the remark that we want this country to be fit for heroes to live in. I want it the same. I believe there is not a man in this room who does not share that wish. But we are only on the fringe of such a possibility. We have to make a healthy country and a clean country first. There is no more beautiful country in the world than England, and yet we are polluting it with smoke every day of our lives. The coal question is at the root of all our trouble—not in regard to the miners' question—but in the way that we use the gift that God has given to this

country and which is going to make or mar it. Science must solve this coal problem. It does not matter if it costs 100 millions of money to do it, it will be cheap in the end. We have untold wealth at our very doors, and we are wasting it like profligates. Perhaps the hard times that we have been going through during the past three or four years will waken us up to the fact that we must make a fresh start and take a bigger view of things than we have done hitherto. If that is going to be the case, then the Institute will play a very important part. My term is now passing, and I have other interests. I shall always remember with pleasure my term of office, and I shall always feel that I have learned more than I have given, because I have been mixing with gentlemen of big minds and big views. It has been said many times that it is not the man who knows the most but the man who adapts what he gets hold of who makes the most progress. Knowledge must not be merely stored up in the mind; it must be applied to utilitarian purposes. It is in the hard school of life that one learns the most. I am looking forward to the time when those who do not wish to assume the responsibility of managing a big business, but who have ideas and are thinking and are studying day in and day out, may be relieved from the dread of impoverishment while they are working out their ideals for the prosperity of the industry. I wish to say, in conclusion, that the President who is going to follow me is a remarkable man; you have made a wise choice, and you will have no regrets. I thank you for the vote which you have accorded me. It has been a great pleasure to be associated with you, and I hope and trust that the gentlemen who follow me in this office, like those gentlemen who have preceded me, will maintain the high standard that we have endeavoured to keep up.

ELECTION OF PRESIDENT

Mr. Emsley.—It is now my pleasure to move that we appoint Mr. William Howarth, J.P., as President of the Institute for the coming year. Mr. Howarth is the managing director of the Fine Spinners' and Doublers' Association. He has had a remarkable career. He commenced, like I did, at the bottom. He was a "half-timer" in 1871, so that he has passed through that phase of the industry. He worked in the mule gate at Bolton for years, and he ultimately accepted an invitation to join the Fine Spinners' and Doublers' Association, and he has attained the position of managing director. He leads the Bolton Master Cotton Spinners' Association as its chairman, and is a prominent member of the Federation of Master Cotton Spinners' Associations. He is interested in Empire cotton growing, and is a member of the Executive Committee of the British Cotton Growing Association of which he was one of the founders. He is also a member of the Council of the Empire Cotton Growing Corporation, and a director of the Liverpool Cotton Association. In Bolton, Mr. Howarth takes an interest in local affairs. He is a magistrate, a member of the Council of the Bolton Chamber of Commerce, and is associated with other public bodies in the Bolton area. He is an authority on various aspects of trade, and at the World Cotton Conference in 1921 he read a paper entitled "The Characteristics of Cotton Required by Spinners and the Present Defects in Raw Material." Gentlemen, you are appointing to-day as your President someone who stands head and shoulders above his compeers in the cotton industry. I think you are making a wise choice. I think he will do something that is required, and that by his encouragement of scientific investigation we shall be enabled to evolve order out of the morass which at present prevails in regard to cotton. As you are all aware, there have been rapid changes and violent fluctuations in regard to both cotton and wool, and it is to such gentlemen as Mr. Howarth that we look for the solution of the problems which confront us. Times are changing, and the artificial silk industry is now coming to the forefront as a result of scientific effort. In regard to flax and hemp, we must again turn to science for assistance in order that our trade may maintain the supremacy it has held hitherto

in those commodities. Once more I have very great pleasure in proposing that Mr. Howarth, whose credentials I have been reading to you, should be appointed our President for the ensuing year, and expressing the hope and assurance that he will lead the Textile Institute to a higher place than it has occupied before.

Col. F. R. McConnel.—It is a very great pleasure to me to be able to second the proposal that my friend Mr. William Howarth should be the President of the Textile Institute. I was little more than a small boy when I was first put to work in a cotton mill which is now part of the Fine Spinners' Association, and I have a great personal pleasure in feeling that the managing director of that magnificent concern should now become the President of the Textile Institute. We have had a most distinguished President who was on the wool side. We are now going in for cotton, and I do hope and trust that the deliberations which will be presided over by Mr. Howarth, as President, will have a lasting effect upon the cotton trade. We all know what a serious position it is in, and how much we long for good guidance as to the proper way of transforming what is certainly not a paying industry at present into one that is. I remember the old days of the Fine Spinners. They had their troubles, but they surmounted them magnificently, very largely owing to the skill and organisation of a previous President, Mr. Nixon. I do hope that just as the Fine Spinners surmounted their difficulties, so the cotton trade will be able to overcome theirs, and that the Textile Institute will take its part in helping to mould the higher form of thought necessary in connection with making the cotton trade once more equal to its old standard of world triumph. I do not think I need say anything more. It will be far better for us to listen to the new President making his presidential remarks. I am sure that at the end of his term of office we will all feel that we have done very wisely in electing Mr. Howarth as our leader.

Mr. William Howarth, J.P., was then unanimously elected.

THE PRESIDENTIAL ADDRESS

The President, in reply, said—Mr. Emsley, Col. McConnel, and gentlemen, we have been advised, in the best Book in the world, that it is very unwise to boast of one's self when putting on our armour; we should rather wait until we are putting it off. Consequently I do not feel capable of saying quite as much to you as I might say were I relinquishing this office. But I have one duty that I must first perform, and that is to thank you for electing me to this distinguished position—a position which does provide, as our retiring President has said, opportunities for service which, if they are not frittered away, may be of great advantage to the community at large. In the comparatively short life of this Institute, the Presidents and the Council who have guided its direction have accomplished a wonderful work. To-day we stand with a Charter empowering us to grant Diplomas. That privilege has been given to us not as an end in itself, but as a means to an end, in order that the Institute can widen its circle of operations and give greater service to the community than it has ever done before. In his valedictory address, Mr. Emsley has measured, very accurately and with a great degree of force, the importance of industry to this country. Personally, I have never permitted myself to be deluded with regard to that matter. There are people who think that banking, insurance, and the carrying on of the various services which are adjuncts to commerce are the important things in the industrial life of this country. From my point of view, they are merely services. If at any time we lose our industries, we shall lose our carrying power, our banking, our insurance, and all the other subsidiary ingredients of commercial organisation. Industry is the basis upon which the prosperity of this country rests, and we who have charge of industry must never allow ourselves to be led away from the acknowledgment of that main factor. We have to justify our Charter, and we have to consider how that may be done. We can see the drift towards associated or communal effort which is a phase of world thought at the present time. I think, now that that drift has come, it will be

a continual force in the life of the world. We, as an Institute, are part of that drift. We must bring our brains together to try and think out the problems of industry, for the purpose of evolving industrial systems which are essential, so that the commercial status that our forefathers built up for us may be maintained. The systems which have raised the nation to present grandeur and to opulence may not necessarily suffice to preserve it in its splendour for the future. We are the heirs of our fathers, and they were great men. I know that there are certain sections of our community who imagine that it was by luck that those who built up our textile trades hit upon the correct methods of accomplishing their end. In parenthesis, may I say that, as President of this Institute, I do not wish to be regarded solely as a "cotton" man. The Institute deals with all classes of textiles—silk, wool, cotton, flax, jute, hemp, and the new synthetic fibres or threads. They should all take equal importance in the mind of a President of an Institute such as this, and so far as I am concerned I shall seek to regard them in that way. But I was trying to tell you that I did not think that the men who built up the industry were ignorant men. They were men who knew all the facts with regard to the forces of nature and of mechanism that were available in their day. By skill, hard work, clear thinking, and the co-operation of those with whom they worked, they built magnificent edifices which for one hundred years have placed this country at the head of the industrial forces of the world. It is important that we should try to maintain that position in the textile world. We need not hide our heads when comparing our profession, as Mr. Emsley has called it, with any other profession practised in this country. I think all of you who have read the history of mankind will agree that the second commodity that mankind found necessary was clothing. We will not go into the nature of the clothing at this particular moment; but from that time forward mankind and civilisation itself, has depended upon the progress which has been made in textiles, in decorative work, and in clothes. In many ways the civilisation of the world has been proportionate to the advances made in the manufacture of textiles. I know that some folks will argue that the art of war has been the main influence in the progress of the world. Well, let them argue. In the early, rude ages of the world it may have been the main stimulant, but after a few ages the factor of clothing must be regarded as the main indication of the progress of civilisation. If there are any who do not believe this, I will recommend them to read a book which used to be read very much in other days—Carlyle's "Sartor Resartus." But the main start in textile industrial progress was not brought about by accident, but by hard work. I want to pay tribute to those teachers who, 40 or 50 years ago, gave the best of their lives and their intelligence for the education of those who were to carry on the trade of this country. Those men had not the equipment or the scientific point of view that our present teachers possess, but they were earnest men with a constructive point of view and a high moral purpose. They endeavoured to instil into the minds of those younger people who came within their sphere of influence principles of the highest morality as well as instruction in the best and most efficient methods of carrying out their work. We cannot forget those old teachers who built into many of us all that we know, and who gave us a chance in life which we have been fortunate enough to work out. But I have got to go beyond that to-day. Since the war finished science has taken hold of the forces of the world in a way that was never thought of before. Every element which contributes to the good of man is being thoroughly analysed. To-day science has a freer hand than it has ever had before in the history of the world, the object being that it shall harness the forces of the world for the good of man without entailing the necessity for any extra human energy. That is the basis, and the only basis, upon which the standard of the life of man can be raised. We have a great outcry in these days that the standard of life must be on such and such a plane, according to the point of view of the man expressing the view; but it is a truism that we can only divide what is produced by the world among the

people of the world. In every seven years, as of old, what is produced in the world is pretty well spread out over the human race, and there is very little left, except in static form, of what was produced seven years before. If we can harness the forces of the world—and we can only do it by the development of the application of scientific principles—then we can raise the standard of life by one of two things. We can either use more commodities ourselves or we can have more leisure. We can make our choice; we cannot have both. So far as I am concerned, I am not really a believer in giving men too much time to play in, unless we have taught them how to use that time for the good of themselves and for the good of humanity at large. First of all, I think we have a need for a common language in order that scientific documents and writings of every description may be intelligible to all who are acquainted with that common language. Many words are now used for scientific purposes which cannot be found in any dictionary, and are therefore unintelligible to the people at large. A common language establishes a common means of transmitting knowledge. The Arabians discussed the motion of the celestial bodies and the doctrine of attraction, but the idea died away until Newton, without knowledge of the Arabic author, made the discoveries in which he had probably been preceded. The Chinese have been working out their celestial compilations, for anything we know, since the Deluge, but the world at large has received no benefit from their work. It is to men like Fust or Coste, who were impelled by the burst of intellectual progress to devise means for the better diffusing of the knowledge already among men, that we acknowledge our debt. The main idea, as far as I can see, that the Textile Institute has to put forward is to vivify the intellectual inertia which lies all around us, and we cannot do it unless we have a language which is understood by all of us. We have a mass of intellect and capacity which is untouched. We have just a few men—not very many—applying themselves to pure science. We do not need a great number of them, but we need the best, and we want the best that they can produce to be at the disposal of all. That is my idea how progress shall be effected. I really believe that the vast majority of people want this scientific pressure to be brought to bear upon them. They certainly will if they can see that an advantage will accrue. I am afraid, however, that there has not been that liaison hitherto between what you may call the education authorities and the ordinary workman which the Textile Institute can bring about, and which ought to be brought about if the status of the Institute is to be properly maintained. I think we can devote ourselves very largely to that end. I think that every technological institution should not merely keep a record of the name, age, and address of the pupil, but should let the employer know the state of proficiency reached by him. All our standard wage systems governing the trade have one defect—that we cannot, without creating trouble, specially remunerate a boy who gives special service. Most of us have heard the phrase that "It is the hope of reward that sweetens labour." We want to teach a boy that by going to the Technical School he will ease his work because he can use his brains and save his body; that he will be able to cut out all sorts of faulty work, and that his production will be in greater quantity as well as of better quality. If the employer could be permitted to recognise that particular extra service, I am quite sure we shall get a burst of enthusiasm for technical knowledge which has hitherto not distinguished the textile industry. I want a student to know for what purpose he is shaping a particular thread. I want his interest to be aroused concerning the object of the work he is doing. I do not know that I want to say very much more with regard to what we should do during the next twelve months. To my own mind the ideas to which I have given expression provide ample opportunity for the exercise of all our wits and wisdom. I have preferred to go on a line that I could carry through, rather than grab at the stars and fail at getting anything. Definitely stated, my view is that this Institute should provide the liaison between the highest research institutions, our technical colleges, and the

ordinary working lad at the very bottom of the tree. We could then, I think, feel quite assured that out of the rut we should get a very great number of young men who would attach themselves to this Institution and seek to develop themselves very much further than what at the present time they seem to be capable of doing. Mr. Emsley is an optimist, and so am I; but I am quite sure of this, that unless we prove ourselves capable of leading the world our textile trades will cease to exist. The history of the world is replete with examples which are best illustrated by the old Grecian tale of the torch, in which the human species engages in a race of intellectual progress in which the bearers of the torch hand it from one to another as they become exhausted, but no one is allowed to take up the torch until he is in the flower of youth, and must hand it on to his next neighbour as soon as age or accident has weakened his frame or retarded his pace. He falls back and dies; his neighbour carries along the torch until he, tco, hands it to another. The torch then, which is humanity, the onward progress of mankind's improvement, whatever may be the goal to which it must ultimately come, has advanced without any perceptible tendency to retrograde movement, while the bearers of the torch, the nations of the world, have fallen away and died when their part in the race of human advancement has been played. As it is with nations, so it is with communities. Unless we can continually run in wider and wider circles, and carry the torch with greater firmness and greater efficiency than can be done by the youth and manhood of other nations, we shall lose the premier position that we hold to-day. If we maintain our premier position, then we shall be able to hand on to our sons the magnificent heritage we received from our forefathers, not merely untarnished but blessed, because we have carried the torch.

ELECTION OF VICE-PRESIDENTS

The General Secretary stated that there were three Vice-Presidential vacancies and that only three nominations had been received. Therefore the gentlemen nominated automatically became elected. Messrs. John Crompton (the present Chairman of the Council), Mr. J. H. Lester, and Mr. Henry P. Greg were thereupon duly elected as Vice-Presidents of the Institute.

ELECTION OF THE COUNCIL: RESULT OF BALLOT

The General Secretary stated that the election of the members of the Council had taken place by ballot. He produced the certificate of the scrutineers of the ballot papers, and in the result the following gentlemen had been elected to fill 10 vacancies—Messrs. T. Fletcher Robinson (Manchester), H. Binns (Bradford), F. Wright (Bolton), E. B. Fry (London), W. E. Baker (Manchester), H. Richardson (Bradford), A. Pollitt (Manchester), E. E. Cockcroft (Luddendenfoot), C. S. Ickringill (Silsden), W. W. L. Lishman (Todmorden).

Mr. C. S. Ickringill moved, and Mr. W. Bailey seconded, that Messrs. Arthur E. Piggott, Son & Co. be reappointed Auditors, and the motion was carried unanimously.

The General Secretary then read the first list of members of the Institute who had been elected Fellows and Associates, as printed in the April issue of this *Journal*.

Mr. William Frost proposed that a cordial vote of thanks be accorded to the staff of the Institute for the excellent manner in which they had discharged their onerous duties. The work had been very arduous, not only for the general staff but also for the staff of the *Journal*, and it was only fitting that their services should be properly appreciated.

Mr. T. Fletcher Robinson seconded. It would very readily be understood that as Treasurer of the Institute it was his privilege and pleasure to come in very close contact with the staff, and he could fully endorse the remarks made by Mr. Frost in regard to the excellent manner in which they had discharged

their responsibilities. The greatest possible harmony and enthusiasm prevailed among the staff, and they were striving in every possible way they could to further the interests of the Institute.

Mr. John Emsley, J.P., supported the motion. Like Mr. Robinson, he had also been in close personal contact with the staff, and, without their cordial co-operation and assistance, it would most certainly not have been possible for him to have done the amount of work he had accomplished. In addition, he would also like to thank from the bottom of his heart all those gentlemen who had spent so much time and showed so much patience in the gaining of the Charter. It had been a work of love, purely and simply. Mere monetary remuneration would never have induced those gentlemen to go to the trouble they did.

The President then put the vote of thanks to the meeting, and it was carried unanimously.

The meeting closed with a vote of thanks to the President.

London Section

Meeting at the Clothworkers' Hall, Mincing Lane, London, 15th March 1926, Mr. F. H. D. Haggard presiding.

RAW WOOL: THE ECONOMIC POSITION

The Chairman, after introducing the Lecturer, Mr. Eldred Hitchcock, C.B.E., thanked Mr. S. M. Townsend, the Master of the Clothworkers' Company, who was present, for the kindness of the Company in lending their hall to the London Section for their public lectures during the winter. Illustrating the benevolence of the Clothworkers' Company to the textile industry, he mentioned that they had given nearly £250,000 in all towards the establishment and maintenance of textile departments at Leeds University.

Mr. Eldred Hitchcock said the economic position of wool, which is measured by price, depends ultimately, like every other commodity, upon supply and demand. The supply and the demand are, however, very wide apart, and many processes and financial transactions take place before the wool in its finished form becomes available to the ultimate consumer—the public. At least a year, and more often longer, elapses between the marketing of the raw wool and the sale to the consumer of the clothes or other articles made from it. The factors which ultimately govern demand are very complex and far removed from those which govern production. Dealing with the question of wool production, the lecturer said raw wool is not a straight article like cotton or steel, and its standardisation (e.g., as cotton is standardised for the purpose of dealing in futures) has not been found in general to be a practical proposition. Statistics of wool production are therefore subject to factors which are not constant owing to the varying nature and condition of the raw material itself, and estimates of production in terms of actual fibre content are at the best rough estimates only. The wool production of the world, especially in the main exporting countries, is fairly accurately known, and the figures can be sufficiently well interpreted by the trade for all practical purposes. Certainly wool production estimates are less difficult to make than are those of the yearly cotton crop. Wool production statistics, unsatisfactory as they may be, need not bother us. The incalculable factor is that of consumption owing not only to the difficulty of collecting the statistics of spindle consumption in each country, but to enormous variations possible in consumption in the spinning of different counts of yarns and to the extent to which substitutes can take the place of virgin wool. Price and fashion react in a wholly incalculable manner upon the weight of new wool passing during any given period through machinery. When to these factors is added that of the machinery capacity employed, it will be readily understood

why estimates of consumption, with the best will in the world to obtain accuracy, can contain margins of error and of difference amounting to 100%. The questions to be foreseen are many, and include—(1) What proportion of the total machine capacity will be working? (2) If this figure be arrived at, what consumption of raw material will this involve? (3) What proportion of new wool will this raw material contain? (4) What effect will change in fashion have upon the counts of yarns required or upon the yardage of cloth necessary? (5) What reaction will fluctuations in price have upon the rate of consumption?

To these questions no one person or committee is clever enough to furnish an answer where the margin of error may not be stupendous. In practice a great number of opinions, arrived at in a variety of ways, for many and diverse reasons, will at least cancel out amongst themselves the more extreme views. In my view the greatest danger is to be feared from any central statistical bureau which attempts to estimate the position at any given time on behalf of traders in general. I have personally had some experience of such methods, and I think it will be found that all the evidence on the subject shows that any central statistical machinery is just as likely—and in fact more likely—to be wrong as right. The method of trial and error on the part of a great number of intelligent units with knowledge of the business will approximate to a net result nearer the truth than any central statistical bureau that can be devised. Having somewhat dogmatically, perhaps, taken up that position I do not wish to suggest that nothing can be done, or that the present position of the statistical data of the trade is satisfactory. What I wish to indicate are its limitations and the very great reserve with which all statistical data must be utilised. I remember Sir Arthur Goldfinch saying some years ago that, after all, "inferential statistics" were the only wool statistics worth while. There was much wisdom in that remark, and I would add that the greater the number of individuals with knowledge of the business who make the inferences, the nearer we are likely to get to the truth of the matter. The whole art of wool statistics is the art of interpretation based on knowledge, and it does not lend itself to any great degree of scientific treatment. But that assumes at least that some attempt is made first to collect what evidence in the form of systematic statistics can be made available, and secondly that members of the wool trade throughout the world will seriously interest themselves in the subject, even if only to the extent of appreciating the serious limitations to which all statistical data, and especially that of the wool trade, is subject. The more information obtained the better, so long as we do not exaggerate its practical value. In any case statistics rapidly become out of date, and a rapid approximate statement is almost always of greater value than a delayed statement, however complete. Having said that, there are certain broad facts to which attention should be directed. Firstly, it is clear that taking the Western and Eastern World together, there is, over a period of years, a definite and steady increase in the demand for clothing and other goods made from wool or in which wool at any rate forms a part, and at the same time the spindle capacity of the world is also steadily increasing, and it is just as clear that the sheep population of the world, and even the wool yield of their fleeces, is not increasing in the same proportion. Secondly, it is also true that not more than a certain proportion of the total purchasing power of the populations of the world is available for the purchase of clothes, and especially of woollen clothes. Price plays an undiminished, and, in fact, increasingly important factor in determining the volume of clothes bought, and so long as the price of clothes is above the general level of prices and of the cost of living, so long will consumption of clothes and of wool be restricted. The lecturer said he left out of account somewhat exceptional, though by no means unimportant, factors, such as the relative decline in textile purchases by a population such as that of the U.S. resulting from the increase in the distribution of purchasing power on such articles as motor cars. That is a phenomenon which was rarely alluded to in works on economics. We must consider, he continued, the effect of price

on wool demand. Meanwhile, it is convenient to compare to-day's with the pre-war price of wool, although it was not necessarily suggested that what was right pre-war should obtain now, but it was at any rate a useful basis for comparison. Where before the war the great wool exporting countries—comprising roughly two-thirds the British Empire and one-third South America—received from the great importing countries—mainly England, France, and Germany—at most about £50,000,000 for their wool in a good year, the price level to which wool had climbed by December 1924, was approximately £150,000,000. In the economic position of the world at that time the extra £100,000,000 for raw wool was obviously a figure at which the wool could not be absorbed. I say "obviously" for in the previous July I had published an article pointing out what seemed at the time to be this very elementary truth. The misinterpretation of the statistical position, and the neglect by the great majority of individual members of the trade of any serious consideration of the position, and the tendency to follow a lead, produced a psychology under which any price level would have seemed a perfectly natural and justifiable one, until the hard facts of ultimate supply and demand reversed the whole position with a bump. Happily the position to-day is on a sound basis, and wool can be bought on an average at little more than 50% over the pre-war figure, or, say, £75,000,000, for the clips. In relation to the general level of wholesale prices, that is a sound and even favourable position. Unfortunately, however, that is not the whole of the story, for after all the ultimate consumer upon whose purchases everybody depends, does not buy raw wool, or even tops or yarns or cloth. He or she buys clothes, and so far as can be ascertained, quality for quality, clothes are still at least double the pre-war price. It will be pointed out that this is due to perfectly good reasons—higher rents, shorter hours, lower production, higher wages, rates, taxation, legal enactments and administrative efficiency, to say nothing of the high cost of cotton. I can only agree, and at the same time point out that the net result is less business, higher costs, and restricted consumption. I often hear friends of mine talk of the high profits and prosperous condition of the wool textile industry. I hope that is so in some cases, but when I ask for the particular cases, I am generally referred to the published balance sheets of some association of commission firms engaged on subsidiary processes of dyeing, combing, and so on, or to the almost fabulous profits of the retail stores, who generally add to their cost price from the manufacturer or the merchant a margin equal or even greater than the combined amounts received by the grower, the financier, the shipping company, the wool merchant, the comber, the dyer, the spinner, and the manufacturer of the cloth. I don't say that there are not perfectly good explanations, but it is quite clear that the great textile manufacturing industry of this country and the wool production industry of the Empire, are both restricted in their market as a result of the high prices which the public is asked to pay for clothing, prices very much above the general level of prices and the cost of living. For years past manufacturers' capital has been oozing away, and even to-day, when trade portents are brighter, in most parts of the country not more than 50% to 60% of the capacity of the looms are unemployed. This state of affairs is a definite tax upon production and upon the wealth of the country—its maintenance restricts business not only within the countries of Great Britain, but by increasing costs reduces our export trade. Over half the value of all our exports of manufactured goods, even including coal, consists of textile goods, and it is therefore by far and away our most important industry. Certainly conditions are becoming better, but in spite of retailers' lavish display and their advertising appeals which are all to the good, trade will not recover till retail charges are lowered. We have, of course, to remember what I mentioned at the outset of these remarks, viz., that supply and demand were often far apart, and it may be that the retail trade is in part absorbing some of the indiscretions of the raw wool trade of eighteen months ago. I don't for a moment set out to teach anyone his business, and

I do not apply my remarks to private trade alone. Government services still charge extravagantly, and co-operative shops are just as relatively expensive. It may be that the remuneration of labour, of capital, and other services in the later stages of production and distribution before the war was too low. I can, however, only point out the relative discrepancy in price levels and the inevitable restriction of sales and of business which follows. The public in many respects may have lost its sense of discrimination, of quality, and of values, but gradually and surely prudence and care in purchasing is returning, and the more that is encouraged, and cheapness and abundance stimulates trade, the greater will be the demand upon our Imperial resources of wool production with reciprocal Imperial trade, without which the trade and prosperity of this country cannot revive, or its people be employed. If we can only overcome some of the difficulties to which I have referred the wool textile trades will boom. They are at present on a perfectly sound basis, and in spite of a temporary reduction of world machine consumption to almost 50%, price is steady and large quantities of wool are being absorbed. The universal financial stringency has been a saviour in disguise, for by it high prices and undue speculation have been checked. There is a large and expanding world consumption to be met, but the point is, it can only be met at a price. In my view, any appreciable increase in wool values will restrict business to an extent which will damage the trade. Wool values are not on a very reasonable level, and it only needs the position of the raw material to be translated to the finished article available to the public for a steady increase in business to result. The great difficulty which will then emerge will be the insufficiency of wool production. It sounds strange to say that to-day, but that will clearly become the position. In this connection we have happily an enormous volume of substitutes, from torn-up woollen clothing to the latest vegetable fibre masquerading as wool. No fibre at present on the market can remotely give the essential qualities possessed by new wool. But they are all useful, and will be increasingly wanted both for making the cloth production required possible, and also for serving as a governor for the maintenance of reasonable price. Change in women's clothes, both as to quantity and the materials from which they are made, have greatly reduced the amount of wool required, but this is more than offset by the world increase in demand, especially in the countries of the Far East. Since the war there has never been a time when the economic position of wool was sounder than it is to-day. Price fluctuation resulting from the natural operation of supply and demand is the only automatic governor on the process of production and distribution. Instead of rushing supplies forward during a part of the season available, supplies are now allocated over a series of auctions throughout the season. In this respect Australia has followed London, and, if I may say so, improved on the model. In addition to this loose control suggestions of various kinds have been made for increasing such restrictions with the object of flattening out cyclical fluctuations in price, and with the experience of B.A.W.R.A. in mind, and especially of the high prices which wool fetched during the period of that control, these various proposals have culminated in the suggestions sponsored by Sir John Higgins for a stabilisation scheme for Australian wool on which I should like to say a word as to its general bearing. I think in this connection we should remember that wool is an article of common everyday consumption by the masses of the population, and that any formal attempt especially by Governments, having even the appearance of forcing up prices, is likely to lead to international complications and retaliation, such as American retaliation on cotton. In these matters therefore one country does not stand alone, and especially does this apply to countries within the British Empire. The operation of such proposals might well result in serious economic as well as political difficulties, which it is our business at least to foresee well in advance. If Australia says that in any given season her wool growers shall not receive less than the fair cost, including

a reasonable return for growing wool, and that I think is the basis of the proposals, she is perfectly entitled to take what means she thinks fit to achieve this end. What she cannot do, without great harm to her ultimate interests and to those of the rest of the world, is to force a level of prices which the general public cannot or will not afford to pay. She will merely restrict her market and drive demand either to substitutes or to other competing producing centres. What I suggest would meet the very legitimate case of the grower is a scheme run and controlled by growers themselves for insuring their own risks by the setting up of a central reserve or pool contributed to in good times by a levy per bale of wool exported or sold, the amount of the levy varying with the level of wool prices. If such a central fund could be built up—and the period of good prices upon which we can in all probability depend for some time ahead would make the present a good time in which to start it, provision could be made for meeting the margin necessary in really bad times, without courting antagonism from other interests concerned or other Governments. Australia is entitled to make whatever arrangements she likes for her own security. A very fair share of the burden for ensuring Imperial security by means of the Navy is in fact largely borne by this country, and to augment this tax by increasing the price of the raw material, upon the cheapness of which our ability to meet the cost depends, is not, I think, to the best interests of the Empire. During the period of the war and for some time afterwards that burden was a very great one to this country. Here I would like to interpolate a little history. It is generally assumed that the Imperial Wool Purchase which was arranged in September, 1915, was arranged mainly on the initiative of the British Government in order to ensure military supplies. It is quite true that was the position, placed some little time before that, before the representatives of Australia and New Zealand by Lord Derby, who was then Minister for War. But his proposal applied to crossbred wool alone, i.e., to not more than 15% of the Australian clip, and practically the whole of the New Zealand production. That proposal had, however, for certain reasons been dropped, and it was not till some time later that the matter was taken up by cable by Mr. Hughes on behalf of Australia with Mr. Bonar Law, who was then at the Colonial Office. In view of the increasing possibility of the diversion of a large part of the mercantile marine from the long Australian route to the short Atlantic one, of the growing intensity of the submarine campaign, and to the possibility of the need for bringing over an American army and supplies to Europe, Mr. Hughes regarded with apprehension the possibility of unshipped and unmarketable Australian wool and other products accumulating at her ports, imperilling the whole financial future of that great Commonwealth. Under such conditions his tenure as Prime Minister—and I mean this in no bad sense—would have been unstable, and the important political issues with which he was then faced would have been lost. He therefore cabled to Mr. Bonar Law urging on these grounds that the Imperial Government should agree to purchase all Australian wool and to pay for it whether it was shipped or not. As it turned out the purchase proved eventually to be good business for both Governments to the extent of £60,000,000, and Australian growers had never known more prosperous times than they experienced under the scheme and that of B.A.W.R.A., which was an extension under another name. That was a great experiment made to meet exceptional and unprecedented circumstances, but it does not provide an analogy for meeting the entirely different conditions of to-day.

The Chairman said, as the representative of a firm in close touch with Australian interests, that he could find no holes to pick in Mr. Hitchcock's paper, which he thought contained many extremely valuable suggestions. He personally agreed with Mr. Hitchcock on every point, and would like to congratulate him on his extremely interesting paper. He proposed a vote of thanks to the lecturer, and this was carried with applause.

COMMUNICATION

To the Editor

Dear Sir,—There is a matter which calls for comment in the excellent paper of Clibbens and Geake on "The Absorption of Methylene Blue from Buffered Solutions." On page T148 they state—" . . . the absorbing hydrocelluloses contained sulphuric acid in some *unknown combination* (italics mine) which could not be broken down by boiling with dilute alkalies," and again on page T166, " . . . the conclusion appears unavoidable that acid is consumed in reactions other than true hydrocellulose formation." Quite so. There is formed a cellulose sulphuric ester (cellulose hydrogen sulphate) exactly analogous in reactions to ethyl hydrogen sulphate, in regard to stability to acids and alkalies. Boiling with caustic alkali simply forms an alkali salt which is quite stable to alkali.

The sulphuric ester may be decomposed either by boiling with alcohol according to the scheme—

$$R.O.SO_3H + Et.OH = R.OH + Et.O.SO_3H$$

or by hydrolysis at the boil with dilute acids.

Cellulose sulphuric ester is encountered in both the nitrate and acetate industries when sulphuric acid is used as catalyst. For example, in cellulose acetate as much as 1% sulphuric acid may be combined during the course of manufacture, and is only removed by acid hydrolysis.

It is therefore erroneous to imply that the mode of combination of the sulphuric acid in the case before us is *unknown.*

Yours faithfully,

56 Oxford Street, Manchester. (Signed) FREDK. C. WOOD, M.Sc., F.I.C.

NOTES AND NOTICES

Annual Conference Cancellation

Although this note may not actually reach members prior to the dates selected for the Institute's Annual Conference, it may be useful to record the circumstances under which the decision to cancel the Conference was reached. The matter was discussed with the President (Mr. Wm. Howarth J.P.), and it was felt, even so early as the 6th May, that the whole situation was doubtful. It was decided to call an immediate meeting of the Committee in charge of the Buxton Conference arrangements. Having regard to the necessarily small response to the invitation and attendance form issued, it was agreed that even in the event of an early cessation of the general strike the complications of the situation would militate against a really satisfactory attendance. It was resolved therefore to cancel the Conference forthwith. The General Secretary telephoned several officers of the Institute, and found that the suggested cancellation was commonly regarded as desirable. The Committee referred to also agreed that the meeting of Council for May (19th May) should not be called. The question of holding the Conference at a later date was referred to next Council meeting, which was expected to take place on the third Wednesday in June. After the decision to cancel the Conference, members who had notified attendance were communicated with direct, whilst the British Broadcasting Company kindly announced the cancellation by wireless.

Membership of Institute and Description

Prior to the obtaining of the Royal Charter of Incorporation, a tendency on the part of a very limited number of members of the Institute to use abbreviations after their names—"M.Text.I." or "M.Text.Inst." for instance—was noted. The official attitude in regard to the practice varied from time to time,

but generally the attitude may now be best described, perhaps, as having been one of toleration. Now that facilities exist, by virtue of the provisions of the Charter, for the securing of Diplomas of qualification in textile technology in connection with membership of the Institute, the use of abbreviations other than A.T.I. or F.T.I. is definitely forbidden. Several instances have already arisen in which it has been found necessary to request discontinuance of the use of abbreviations to indicate merely ordinary membership of the Institute. The only form of description of ordinary membership which can now be permitted is the addition to the name of the description, in full, "Member of the Textile Institute." No abbreviation is allowable other than the abbreviations associated with the Diplomas of the Institute, and members who have previously used abbreviations in connection with ordinary membership should note carefully the demand for discontinuance.

Diplomas of the Textile Institute
Awards of Fellowships and Associateships

Fellows

DAVENPORT, Bertram (Hyde, near Manchester).
WIGGLESWORTH, Alfred (London).

Associates

ATKINSON, David (Nelson).
BARKER, Charles (Blackburn).
BARNSHAW, Charles (Blackburn).
GREEVES, Owden V. (Portadown).
HALL, Robert Swainson (Calcutta).
HEALEY, James Russell (Bradford).
HEY, John Maden (Swinton, near Manchester).
HUTTON, Charles (Bradford).
KING, W. Edgar (Bradford).
LAWSON, Thomas Marsland (Burnley).
LOCKIE, John Ritchie (Paisley).
LONG, George (Frizinghall).
ROBINSON, Thomas Hughes (Bradford).
SHACKLETON, George (Bradford).
TINDALL, Arthur Richard (Bradford).
WINDLE, Joseph (Nelson).
WOODHEAD, Arthur (Shipley).

Elected to Institute Membership

At the April meeting of the Council, the following were elected to membership of the Institute—Norman Booth (Textile Teacher), 46 Greenhead Lane, Dalton, Huddersfield; Vasudeo Bose (Carder and Spinner), 70 Cantonments, Bareilly, U.P. India; Bertram Cheetham (Weaving Student), "Coniston," Cote Green, Ludworth, near Stockport; William B. Elliot (Tweed Designer), 5 Ann Street, Tillicoultry, Scotland; George S. Ferrier (Research Chemist), 10 Hamilton Park Terrace, Hillhead, Glasgow; Percy H. Gee (Textile Teacher), 15 Springwood Street, Huddersfield; James Greenwood (Teacher of Textile Design and Colour), 78 Chatburn Road, Clitheroe; William A. Grocott (Power Loom Overlooker and Lecturer), 33 Yarborough Street, Pendleton; Harald Hygrell (Manager of Spinning and Weaving), Karlshamn, Sweden; G. N. K. Iyer (Mill Manager), c/o N. B. Vyas, Esq., Headmaster, Weaving School, Bulsar (*via* Bombay), India; James A. Lord (Textile Student), 196 Walmersley Road, Bury; D. N. R. McEwan (Chief Chemist), c/o Wolsey, Limited, Abbey Meadow Mills, Leicester; Frank W. Oldham (Cotton Mill Manager), 2 Holly Grove, Hollins Lane, Accrington; John S. Pearson (Assistant Mill Manager), c/o Mr. F. Wilson, 215 Drake Street, Rochdale; John B. Percival (Chartered Patent Agent), 20-22 St. Ann's Square, Manchester; Arthur Riley (Manufacturers' Clerk and Textile Student), 11 Eldon Road, Edgeley, Stockport; Herbert T. Rothwell (Textile Teacher), 35 Dalton Green Lane, Dalton, Huddersfield; Ralph P. Richardson (Spinning Master), Technological Research Laboratory, King's Circle, Matunga, Bombay, India; Charles W. Schoffstall, 1474 Columbia Road, N.W., Apt. 410, Washington D.C., U.S.A.; Robert Sewell (Manager, Broadstone Mills, Reddish), 286 Wellington Road North, Heaton Chapel, near Stockport; W. Farrar Vickers

(Oil Refiner and Manufacturer), Gascoigne Street, Boar Lane, Leeds; Harold A. Wilkinson (Assistant, Cotton Section), Messrs. Begg Sutherland & Co., Ltd., Cawnpore, India; Leonard Wilkinson (Instructor in Weaving), 17 Melford Street, Dudley Hill, Bradford; Thomas S. Wilson (Bobbin Manufacturer), c/o Wilson Bros. Bobbin Co. Ltd., Cornholme Works, Garston, Liverpool.

GENERAL ITEMS AND REPORTS

Proposed International Wool Federation

M. Maurice Dubrulle, in giving an address before the Bradford Textile Society on Monday, 1st March (Mr. Sydney E. Illingworth presiding), entitled "International Co-operation in Relation to Wool Production and Consumption," said that the wool growers' conferences inaugurated by the Bradford Chamber of Commerce had proved most fertile in the cultivation of a desirable co-operation between all those engaged in the production and distribution of the raw material, and the foundations for international co-operation had been laid by the recent arbitration agreement between England, France, Belgium, and Germany. Amongst matters calling for international action were the questions of wool supplies, of packing of wool, statistics of consumption, interchange of technical knowledge, and of business credits. Another line of action was the influencing of fashion. Whereas a few years ago at least four yards of material were required for a lady's garment, in these days two yards were more than sufficient. A change of fashion with a view to providing more employment for machinery could only be achieved by a world campaign conducted at one and the same time, and mainly from the large capitals such as London, New York, Paris and Berlin. With regard to the question of how co-operation could be effected, M. Dubrulle said he was convinced that success could only be achieved by a proper co-ordination of many individual and partial endeavours into one vast international organisation which would comprise representatives from every country for the collation, investigation, and resolution of the many questions in which they were all equally interested. In advancing a concrete suggestion, he would propose that an International Wool Federation should be the basis of this endeavour. He could imagine that its functions would be delegated to three important committees—firstly, a committee to further technical co-operation to deal with wool supplies, sheep-breeding, and wool packing, &c. A statistical bureau could also be organised by this department to receive from each national branch of the Federation periodical statistics of wool consumption and production. Secondly, a committee to further technical co-operation, which would be aided by a central research laboratory where the examination and classification of all discoveries or improvements of recognised value to the worsted and woollen trade would be undertaken. Thirdly, a committee to further commercial co-operation in respect to fashions, credits, &c.

Mr. Douglas Hamilton said he hoped Mr. Dubrulle's challenge would be taken up in the spirit in which it was made. He found himself in almost entire agreement with the points raised by Mr. Dubrulle, and stressed the desirability of having reliable statistics.

Col. F. Vernon Willey said he had been impressed by the fact that the world's textile consumption, reckoned as a portion of its budget expenditure, was less than it was before the war. That was a very serious matter both for employers and employed, and it was an outstanding reason for international collaboration. Clearly the present degree of consumption was not going to employ the wool textile machinery of the world. With regard to statistics, he was an unrepentant believer in more attention being given to them. He hoped the wool textile trade would see the wisdom of the movement, if only to refute the charge of inefficiency which was being levelled at the employing class by the workers. In his view the slumps of 1920 and 1925 would have been corrected by adequate statistics. In 1920, had statistics existed, it would have been obvious that it was impossible to pass the volume of wool then existing through the spindles of the world, and therefore, inevitably, prices must have fallen. In 1925 it would have been seen that the forecasts were based upon a continued operation of machinery at the

then existing rate, but that in view of the resources of the trade and the purchasing capacity of the world, it was impossible to pass the amount of wool existing through machinery at its then level of prices, because those prices were out of proportion to the general level of prices as shown in index figures. Statistics did not exist (or were disregarded) to justify either of those two deductions, and he suggested that accurate statistical information would have enabled the trade absolutely to avoid slumps such as the two dramatic slumps of the past six years.

Wool Problems

Mr. Harry Dawson, dealing with "Some Existing Wool Problems" before the Bradford Textile Society on Monday, 15th March (Mr. Sydney E. Illingworth presiding), said that three factors were seriously affecting the wool position to-day. These were (1) finance, (2) fashions, and (3) substitutes. With regard to the first, as a result of the slump in prices in 1925, the financial capacity of the textile industry of the world was probably weaker than for many years. For the first time in fifteen or eighteen months, however, he felt a little more optimistic, and was convinced the worst was over. There was an utter absence of speculative dealing, and because of that prices were more set and on a sound basis. From any point of view—the economic or the commercial—prices were now on a reasonable level, and for the first time in two years trade could be done without a loss by turning wool into semi- or fully-manufactured articles. Another hopeful factor was that home traders were beginning to enjoy an advantage over their Continental competitors owing to the return to the gold standard.

The second factor was that of fashion or preference, which was found in the abnormally strong demand for fine worsteds in preference to cheaper woollens or the coarser crossbred cloths. That was a healthy reaction. Worsted cloths had been in very slack demand for two or three years, owing to the price of wool and the more expensive costs of production. But with good 64's top available at about the four shilling basis, fine worsteds could be produced at a reasonable cost, and reports from every market during the past few weeks had shown a wonderful demand for fine worsteds, and especially for fancy worsteds. This preference had had an immediate effect on the wool market in the finest merinos, and especially 70's. Despite financial tightness and a world-wide bear movement, it was remarkable how steady merinos were keeping in value. Crossbreds, he thought, would take care of themselves. All the wool in the world was wanted. Crossbreds, though neglected to-day, were cheap, and would create a demand.

With regard to the third factor—adulterants and substitutes—the wonderful development of the artificial silk trade had doubtless its effect on the consumption of wool, especially in the United States. Many estimates had been made, and he did not want to take an exaggerated one, but a moderate and conservative estimate made by men having the confidence of statisticians placed the amount of raw wool that had been displaced during the past year at from 600,000 to 800,000 bales.

In the course of the discussion, Mr. H. Kenningham said one curious feature was that despite the poverty of the Continental nations they could go on financing purchases in London and the Colonies, and only at the present London sales they had seen wools go to the Continent at prices which were almost equivalent to the price of the top in Bradford. He would like to ask Mr. Dawson how far the infusion of artificial silk would help to regulate the price of the natural wool.

Mr. Arthur Bentley said the statistics of shipments from the Colonies were given in bales, but sometimes the yield of wool per sheep would be a few ounces different from the yield in the previous season, and that made a great difference to the quantity of wool available.

Mr. Dawson said if the production of artificial silk increased it would have a sobering effect on wool consumption and therefore on prices. With regard to shipments from the Colonies, these were very reliable. The weight per fleece varied, but the weight per bale was practically constant at somewhere near $3\frac{1}{2}$ cwts., because that was the limit of weight laid down by the London Dock authorities.

M.

THE JOURNAL OF THE TEXTILE INSTITUTE

Vol. XVII JUNE 1926 No. 6

PROCEEDINGS

NOTES AND NOTICES

Textile Institute for the United States

American textile journals which reached this country in the early days of June contained references to a proposal for the establishment of a new organisation described as a Textile Institute for the U.S.A. The project was announced at the annual conference of the American Cotton Manufacturers' Association held at Atlanta, Ga. The scheme is of more than passing interest to this country and probably to several other countries concerned with the textile industries. The Textile Institute of Great Britain and Northern Ireland was founded in 1910 and in its early years played an important part in promoting co-operative research. In fact, the Institute itself embarked upon more than one useful research scheme. Now, since the formation of a Government Department of Scientific and Industrial Research and the four Textile Research Associations, the foremost functions of the Textile Institute in the direction of increasing the store of knowledge are the provision of a platform for the discussion of technological and scientific problems and a suitable medium for the publication of scientific and technical literature. The Institute's Royal Charter—granted a year ago—has imposed further obligations on the Institute, those of raising the status of those who profess or practice Textile Technology, and of providing an examining body in connection therewith. The Institute, being empowered to confer post-graduate diplomas (in the form of Fellowships and Associateships) to members who satisfy its examining authority, will be expected, also, to take an active part in all future discussions on the training of textile technologists. Further, the requirements in regard to the publication activities of the Institute may be expected to expand. The records of original work on the part of candidates for diplomas will invariably receive special consideration by the examining body. In consequence, a distinct stimulus to publication is exerted, and such stimulus is already reflected in a heavy increase in the number of papers submitted to the Institute's *Journal*. It will be interesting, therefore, to compare with the above outline of this Institute's functions, the scope of the scheme for a Textile Institute in the U.S.A. Here are the proposals, as tersely summarised in the *Textile World* (U.S.A.) of the 22nd May—

The skeleton plan for a Cotton Textile Institute proposed by George S. Harris at the A.C.M.A. meeting in Atlanta, is as follows—

Organisation

Board of Directors.
Director General.
Chief Statistician.
Technical Experts as required.
Converter (representing Converters' Association),

Wholesaler (representing Wholesale Dry Goods Association).
Retailer (representing Retail Dry Goods Association).
Legal Directors.

Functions

Secure, tabulate, and distribute data covering all phases of industry and commerce affecting cotton textiles.
Check and advise entire industry and trade.
Publish periodically price index by construction groups including all yarns.
Conduct group advertising at home and abroad.
Conduct research relating to extension of use of cotton textiles.
Direct group activities in export trade.
Direct in all legislation affecting cotton textiles.
Direct as to trade customs, settlement of disputes, &c.
Co-ordinate work of existing association.

Although limited to cotton, the project obviously covers a vast field, and in calling attention to the wide scope and variety of the activities contemplated our object is not to offer criticism thereon. Nevertheless, the suggestion may be ventured that the selection of the title of "Textile Institute" for an organisation so widely different in its conception from our own Textile Institute, is possibly unfortunate, and may lead to some confusion. Our own Institute is recognised in all textile countries for its special interest in a particular field of activity, and already has Fellows in America. Though the numbers of such members may be few, the interest in our monthly *Journal* extends considerably beyond the membership circle, as is shown not only by the increasing number of U.S.A. subscribers but by the extensive quotation and often complete republication of matter from our pages in American textile periodicals. The possibility of a Textile Institute for the U.S.A. raises the hope, at any rate, that, in the not too distant future, publication of scientific textile literature in America may be associated with mutual exchange facilities in relation to the output in this country.

The Council of the Institute

At the meeting of the Council on Wednesday, 16th June, the newly-elected President (Wm. Howarth Esq. J.P.) occupied the chair at the outset, pending the election of chairman. Mr. John Crompton was unanimously re-elected to the chair, whilst Mr. T. Holdsworth was reappointed vice-chairman. Other elections were in contemplation, including the various committees, but in this instance it was decided that the chairmen of the respective committees should meet at an early date and make recommendations for the next meeting. The Hon. Secretary (Mr. W. Frost) and the Hon. Treasurer (Mr. T. Fletcher Robinson) were unanimously reappointed. The General Secretary called attention to the fact that owing to elevations to vice-presidency and to one resignation—that of of Dr. W. L. Balls—five vacancies had arisen in council membership. It was decided to refer to the recent ballot in connection with the annual election of the Council, and it was agreed that the first five who did not then secure seats be now elected. Accordingly, Messrs. W. Wilkinson (Blackburn), E. Midgley (Bradford), A. B. Shearer (Manchester), S. Watson (Hyde), and W. Kershaw (Manchester), were declared elected. With regard to the Yorkshire Section and the London Section Committees, the nominations of the Sections were approved and the lists of names of these committees appear on another page of this issue.

Delay of the Institute Annual Conference

Although considerable regret was expressed on account of the necessity which had arisen for the postponement of the Institute's Annual Conference, which should have taken place at Buxton during Whit-week, yet it was felt to be

inadvisable under present conditions to consider anything like immediate re-arrangement of the event. It was agreed, therefore, that the question of date of the fixture be placed upon the agenda for next meeting. The general opinion of the Council appeared to be that October would be the most advantageous time at which the Conference might take place. The hope was definitely expressed that the two important papers announced for the postponed Buxton Conference would be still available, whilst Mr. W. Frost found general acceptance for his suggestion that the venue for the fixture should remain as previously—Buxton. In considering the whole matter, attention was drawn to the fact that Manchester Civic Week was to be observed between the 3rd and 9th October. The Lord Mayor of Manchester, it was reported, had communicated with the President, and had suggested that the Institute might organise a Textile Exhibition during that week. The Council, however, appreciated the difficulty of organising an exhibition which would be of interest to the general public, and which would indicate the scope of the Institute's activities. The suggestion was forthcoming that in the event of any wireless broadcasting programme being arranged in connection with the Civic Week, the Institute would be pleased to undertake contributions thereto.

Work of the Propaganda Committee

This Committee of the Institute, formed some time ago to deal with special matters in relation to propaganda, has made substantial contribution to the activities of the organisation. At the outset the prospects appeared to be that its work would be of a more or less temporary character. Latterly, however, the demands upon it have increased and it would appear that its permanence will prove necessary. Already, the newly-constituted Council has referred many matters of organisation to this Committee, including special consideration of more or less difficult problems in connection with the advancement of certain of the Institute Sections. So far as sectional activity in Scotland is concerned, special difficulty arises owing to the somewhat long distances which separate the respective textile centres. The Propaganda Committee will also give consideration to a movement for resuscitating the Section Committee at Belfast, in which connection it is gratifying to record that Mr. F. Anderson, of Portadown, has kindly consented to assist in this direction. The Propaganda Committee is also charged with giving consideration to the interest which the Institute might develop in connection with the meeting of the British Association at Leeds in 1927.

Membership of the Institute

At the June meeting of the Council, the following were elected to membership of the Institute—Messrs. Norman H. Buckley, 1 Hardwick Street, Keighley, Yorks. (Pupil to Patent Agent); F. Arthur Burden, 229 Regent Street, London W.1. (Export Manager, Hosiery Firm); Joseph Clay, The Riddings, Long Preston, Leeds (Wool and Yarn Merchant); John H. Cooke, 17 Altrincham Street, Manchester (Velvet Manufacturer); James Duckworth, 139 Cleaver Street, Burnley, Lancs. (Assistant, Weaving Department, British Celanese Ltd., Spondon, nr. Derby); Edward Dunkerley, 32 Brewerton Road, Oldham (Cotton Mill Carder and Teacher of Cotton Spinning); W. C. Fenton, Spen Hall, Cleckheaton, Yorks. (Mechanical Textile Manufacturer); Leon. Frenkel, 153 Moorgate, London E.C.2 (Olive Oil Producer); Norman Gregson, 219 Greenmount Lane, Heaton, Bolton (Cardroom Apprentice); Thomas Hadfield, 19 Kelvin Street, Darwen (Textile Chemist); Miss Regine Hausman, c/o *Manchester Guardian Commercial*, 3 Cross Street, Manchester (Journalist); Messrs. Frank Hill, "New Lynn," Livesey Branch Road, Livesey, Blackburn (Teacher of Cotton Spinning); James T. Hodgson, Bastwell Dye Works, Blackburn (Chemist and Dyer); Dr. H. B. Holsboer, Director of The High Textile School, Enschede, Holland; N. D. Long, 20 Park Row, Leeds (Textile Specialities); Beaumont Mettrick, 112 Woodside

Road, Huddersfield (Teacher of Textile Technology); Charles E. Mullin, 3rd and Jackson Streets, Camden, N.J., U.S.A. (Consulting Chemist); Percy Rhodes, 40 Reevy Road, Wibsey, Bradford, Yorks. (Weaving Manager); Harold M. Scott, c/o Messrs. Robert Clay Ltd., Cheadle, Cheshire (Textile Chemist); Allan Tempest, Cawnpore Woollen Mills, Cawnpore, India (Manager, Worsted Carding and Combing); Thomas C. Woodman, 9 Hampton Road, Teddington, Middlesex (Textile Scientist).

Publications added to the Institute Library

April—June 1926

Books

Chimie et Industrie. 1914-1924. Dix Ans D'Efforts Scientifiques Industriels et Coloniaux.
Die Kunstseide. Dr. Valentin Hottenroth.
Tissus Impermeables. D. de Prat.
"Electrician." Annual Tables of Electricity Undertaking. 1926.

Pamphlets

British

Ministry of Agriculture and Fisheries. Report on Wool Marketing in England and Wales.
British Cotton Growing Association. (*a*) Transport in Africa; (*b*) 21st Annual Report.
Bannerman's, Manchester. An Historical Record.
Bradford Technical College. Prospectus of Summer Courses.
Manchester and District Cotton Employers' Association. "Macara" Presentation Booklet.

Colonial

Agricultural Research Institute, Pusa. Bulletin No. 164.
Indian Central Cotton Committee—
Papers read at Indian Science Congress, January 1926.
Annual Report, 1925.
Union of South Africa Department of Agriculture—
Science Bulletins 43, 44, and 46.
Monthly Trade Report, December 1925.
India Department of Agriculture. Bihar and Orissa. Second, Third, and Fourth Reports on Cotton Crops.
Dominion of Canada. National Research Council. (*a*) Report No. 16; (*b*) Report of the President.
Colony and Protectorate of Kenya. Annual Report, 1925.
Queensland. Minister of Agriculture. Reports on Experimental Work on Cotton.

Foreign

U.S.A. Department of Commerce. Elimination of Waste Series. No. 16.
U.S.A. Department of Agriculture. Breeding Work with Field Crops.
U.S.A. Bureau of Standards. Handbook No. 7; Circulars 281 and 282; Technologic Papers 303, 305, 306, 308, 310, 311, and 312.
U.S.A. Lowell Textile School Quarterly Bulletin.
Louisiana Agricultural Bulletin No. 193.
University of Wyoming Agricultural Bulletin No. 141.
North Dakota Agricultural College. Bulletins 191, 192, and 193.
Silk Association of America. 54th Annual Report.
Hawaii Agricultural Experimental Station Report.
Ministry of Agricultural Egypt. Technical and Scientific Bulletins 57, 62, 66, and 69.
Ingeniors Vetenskaps Akademien. Handlingar. Nos. 47 and 48.

Catalogues

Bridge's Rubber Plantation Machinery. 1926.

COMMUNICATIONS

To the Editor

Dear Sir,—On page P62 of the *Journal* for April 1926 in the report of the discussion which followed the paper by Mr. G. H. Buckley on the knitting of artificial silk, the following statement is attributed to the lecturer—"—in the making of lace, which is, of course, a twist and not a loop fabric."

Mr. Buckley must have overlooked the fact that one of the earliest forms of needle-point, that is, crochet lace, is entirely a loop fabric, and further that the button-hole stitch used in making the "vrai reseau" of needle-point lace is itself a loop.

In addition, I would point out that for many years loop laces have been made on the Levers lace machine, the warp lace machine, and all the modern derivatives of the latter, including the Hakel-galon or crochet lace machine. It is evident that there is some confusion concerning the stitches which are the basis of lace, and this confusion appears to arise from the fact that all knots, crochet loops, and button-hole stitches are twist—and therefore lace—loops clearly distinguishable from the plain or weft loop known as the knitting stitch.

It is the custom in the hosiery trade to-day to talk of warp knitting and weft knitting. Since the stitch is a mechanical unit upon which all textile construction is based, it is necessary to distinguish plain, that is non-twist stitches, from twist or lace stitches, and I venture to assert that the modern classification of knitting, so far as it classifies openwork twist-loop fabrics as hosiery, instead of lace, is in error.

Yours faithfully,
(Signed) JAS. L. LITCHFIELD.

7a Friar Lane, Nottingham.

To the Editor

A Case of Woodboring Beetles Damaging Bobbins and Yarn

Dear Sir,—There has recently come under my observation a case of a textile fault which is unique in my experience and knowledge. Worsted yarn had been wound into cheese form on wooden bobbins which had become infested with woodboring beetles of the species *Anobium punctatatum* De Geer, the common furniture beetle. The larvæ of this beetle are small, six-legged, whitish grubs which live inside wood, drawing their nourishment from the wood itself and always remaining hidden below the surface so that a piece of wood may be honeycombed and rotten with their tunnels or burrows, and yet apparently sound. On reaching maturity they burrow to just beneath the surface of the wood and there make a cell in which they pupate. When the beetle emerges from the pupa it waits until its body and jaws harden and then bores its way to the outside where it immediately goes in search of a mate. The larvæ are specially adapted for living in burrows inside wood except when newly hatched or very young. They have the greatest difficulty in walking or even moving about at all on the surface, and in any case could not derive their necessary sustenance from wool. A very good account of the life and habits of this and other woodboring beetles commonly found in this country together with the methods of dealing with them is given in "Furniture Beetles," by C. J. Graham, D.Sc., being Economic Pamphlet No. 11 issued by the British Museum (Natural History).

In the above case the presence of the beetles was not discovered until the yarn came to be unwound, when it was found to be cut up into short lengths and so totally ruined. The mature beetles had made their way out of the bobbins and tunnelled through the yarn also. The bobbins were absolutely honeycombed with the powder-filled burrows of the larvæ and numerous holes about $\frac{1}{16}$ inch in diameter were to be seen where the mature beetles had made their way out.

The yarn also was cut up and totally ruined by the long straight tunnels drilled through it by the beetles in escaping. It is perhaps as well to emphasise the fact that it was the mature beetles and not the larvæ which damaged the wool and that the wool afforded them no nourishment at all and was attacked because it happened to be in the way to freedom. In normal circumstances there is not the slightest danger of the beetle attacking wool or any other textile fibre. So far it has not been possible to ascertain where or when the bobbins became infested with these beetles. That it happened before they left the spinners is certain, as unfortunately the trouble was not discovered until the greater part of the yarn had been delivered to various customers; in fact, attention was first drawn to it by complaints arriving in from several of them. The fact that the trouble came to a head in several widely separated places proves that it was not a case of infestation after leaving the spinners' hands. The beetles may have been present in the wood the bobbins were made from or the bobbins may have become infested later whilst in store. Apparently there were no signs of their presence when the yarn was wound on to the bobbins, but it is well to remember that even if there had been a few worm holes visible at that time, it is hardly likely that the operative would have noticed them, or even if she did that she would have known what they were. Although of course the destruction of the yarn and the annoyance caused the customers is serious it is by no means the worst feature of the case. The real trouble is that for the next few years it will be necessary to be on the lookout for, and take precautions against, this wood pest in all the sheds in which these bobbins have been, because there is every possibility that the beetles which have emerged have mated and may have subsequently infested the woodwork present in the sheds both as structural parts such as beams and floors, and also in the form of bobbins, skeps, and machine parts.

Yours faithfully,

(Signed) C. O. CLARK.

61 Catford Hill,
London S.E.6.

REVIEWS

Rubber and its Uses in Building Works. H. P. Stevens and B. D. Porritt. Issued by the Rubber Growers' Association, Inc., 2, 3, and 4 Idol Lane, London, E.C.3.

A brochure issued by the Propaganda Department of the Rubber Growers' Association with a view to stimulating more general use of rubber in trades and industries. Written by two experts in the rubber industry, the text is in no sense a catalogue of articles and products of which rubber forms the basis, but a broad outline of the substance and the modifications of which it is capable to meet special requirements. The qualities of rubber render it particularly suitable to solve many of the technical problems of the great industries, and the policy of the Association is, therefore, to bring directly to the notice of those engaged in those industries the possibilities of rubber to produce more efficient working, to reduce costs, and to obtain better service. The Secretary writes that the Association will be pleased to supply copies of the booklet on application to him.

J.D.A.

Die Kunstseide. By Dr. Valentin Hottenroth. (Verlag von S. Herzel, Leipzig, 1926.)

In the introduction interesting facts concerning the growth and properties of natural silk are given; then follows the historical development of the artificial silk industry. Réaumur in 1734, in his *Memoire pour servir a l'histoire des insectes*, Vol. 1, p. 154, explained that it must be possible to make fine fibres like silk from solutions of gum or gum-like substances. Braconnot in 1832 made explosive Xyloidin which Schonbeim in 1846 applied as gun cotton, and Audemars in 1855 (E.P.283, 1855) made artificial fibres from solutions of gun cotton in ether and alcohol with addition of rubber. It may be mentioned that some 3,000 years

ago the secretion of silk worms was applied in a similar way for making fibres in the East. E. J. Hughes (E.P.67, 1857) described the preparation of artificial fibres from starch, glue, gums, tannins, fats, &c. Ozanam (*Comp. Rend.*, 1862, Vol. 55, p. 833) proposed to make fibres from a solution of real silk in Schonbeim's solution. In those days chemistry and technology were not ripe for the development of artificial silk. Swan, in 1880, applied cotton fibres, parchmentised with sulphuric acid for the manufacture of carbon filaments for electric light bulbs. Crookes in 1881 used a solution of cellulose in ammoniacal copper oxide, Robertson a solution in zinc chloride, Weston, in 1883, a solution of cellulose nitrate, while Swan, in 1884, used a solution of cellulose nitrate in acetic acid. The *J. Soc. Chem. Ind.*, 1885, **4**, 34, refers to Swan's artificial silk as a new spinning material. Chardonnet in 1884 applied a method very similar to that of Swan, and floated a company for 6,000,000 francs to exploit the process in Besançon; the company lost considerable sums of money and did not pay a dividend until 1894. Another company floated in Speitenbach, Switzerland, also met with difficulties. Other works were erected in Glattbrugg (Switzerland) by Lehner; at Bobingen (Augsburg); Kelsterbach-a-Main; Sarvar (Hungary); Padua and Pavia (Italy); Wolston (England); and also in Belgium (Tubize Company, 1906); In consequence of the explosive nature of cellulose nitrate, attention was paid to other solutions of cellulose and the use of Schweitzer's solution, discovered in 1857, and applied by Weston in 1882, was adopted, notably by Despaissis in France in 1890, and later by Fremery and Urban in Germany. The Vereinigte Glanstoff-fabriken A.-G. was formed at Aachen in 1899 and transferred to Elberfeld in 1909, the works being at Oberbruch (Aachen) and Niedermorschweiter, Mulhouse. Companies related to this were La Soie Artificielle, Paris; and Niederosterreichische Glanzstoff-fabrik A.-G., Vienna, which in 1906 were producing at St. Polten 125 kg. per day, and also the British Glanzstoff Manufacturing Co. Ltd., at Flint (eventually taken over by Courtaulds' Ltd.). In 1891 Viscose was discovered by Cross, Bevan, and Beadle, the patent rights being acquired by Furst Guido Donnersmarck Kunstseide and Acetatwerke, formed to produce 500-600 kg. per day, in Germany, and by Courtaulds in England. The acid salt coagulating bath of Muller and Koppe, patented in 1905 and modified in 1910, obviated most of the difficulties of viscose spinning. Both these patents have now expired in England. Cellulose acetate was first produced in 1865, but not in considerable quantities until recently. Even in 1925 it was not quite decided whether this silk would play a very important part in industry. The difficulties of producing a marketable, especially a level-dyeing product, are very great and have delayed large scale development. Only in recent times have there been any large schemes projected such as those of the British Celanese Ltd., American Cellulose & Chemical Co., and the Lustron Company in America.

One can divide the manufacture of artificial silk into three sections—the preparation of the spinning solution, the spinning process, and the finishing operations. Raw materials are of great importance in the manufacture of spinning solutions, and in the spinning process both the apparatus and the spinning bath must be considered. The finishing processes include washing, bleaching, drying, twisting, dyeing, finishing, &c. All artificial silks of technical importance to-day are cellulose products, and the properties of cellulose are described. An account of the growth of various kinds of cotton fibre is given with much information concerning the properties of cotton cellulose. Mention is made of the recent work of Herzog on the crystalline character of cellulose and a short account of the recovery of linters from cotton seeds is given. An account of the origin, manufacture, and properties of wood pulp follows, with tables showing the percentage of cellulose in different kinds of wood and the amount of pentosan derivatives obtained from each. The manufacture and bleaching of soda-cellulose, sulphate-cellulose, and sulphite-cellulose is described. The impurities in wood-pulp are considered. Other forms of cellulose as well as non-cellulosic compounds used in the manufacture of artificial silk are dealt with. The mechanical and chemical processes applied to cotton to render it suitable for use in the manufacture of artificial silk are described. The important points in the spinning solution are the concentration of the cellulose, the viscosity of the solution, its precipitability, and, finally, its purity. It must be free from particles which might fill up the fine openings of the spinning jets. The spinning process varies with the cellulose compound used as also does the

spinning bath. The following important points are dealt with—the spinning jets; the methods of twisting simultaneously with spinning; the spinning pumps, both wheel and piston; the final filtration process and apparatus; special forms of spinning jets including the rotating jet; the bobbin system of spinning and the centrifuge method. Prints are given of the machinery of O. Kohorn, and C. G. Haubold, of Chemnitz, but not of other firms either in Germany or elsewhere. Several methods of washing and drying bobbins are shown, also methods of twisting and reeling the dried silk. The drying of hanks under tension after centrifuge spinning is mentioned, and bleaching and finishing as well as sorting and testing artificial silk are dealt with in general. The book also deals with special individual methods of manufacturing artificial silk, 72 pages being devoted to nitrocellulose silk; 38 pages to cuprammonium silk; 50 pages to viscose silk; 22 pages to acetate silk; 8 pages to cellulose-ether silks; and 11 pages to various other kinds of silk not of technical value. In relation to nitrocellulose silk the preparation of the cellulose from cotton is first considered, then the theoretical points concerning cellulose nitrates, and after this the practical carrying out of the process of nitration and subsequent washing purification and dyeing, and the recovery of acids. The properties of the cellulose nitrates are considered. The preparation of collodion solutions in the various known solvents is discussed and the wet and dry spinning of collodion silk described, also the de-nitration, washing and drying of the silk as well as the methods of recovering the solvents. In the cuprammonium process the chemistry of the copper compounds with alkalies is dealt with. The preparation of the raw materials, cellulose, and ammoniacal copper solution are described, following which the dissolving of the cellulose in the copper solution and its subsequent filtration are set out. The two methods of spinning using respectively acid and alkaline coagulating baths are considered as well as the stretch spinning process. The removal of copper, recovery of chemicals, and the washing and drying of cuprammonium silk are mentioned. The viscose process is also described in detail, viz., preparation and ripening of alkali cellulose; sulphiding and ripening of viscose solutions; spinning and after-treatment of spun fibres to the finished state. The methods of analysis of viscose, several of which were originated by the author, are given in detail. The various spinning baths proposed for viscose silk spinning are mentioned, including the recent inventions. The acetate and ether silks are not described so fully, presumably because the literature on these subjects is rather diffuse and information of practical value is not yet public property. The dyeing of artificial silks is dealt with in 16 pages and includes short accounts of all the processes applied to acetate silk. The physical and chemical properties of artificial silk are given in 14 pages. The application of artificial silk in weaving, alone, and with other fibres is dealt with as well as several other special subjects. Figures of production in various countries since 1896 are given with a list of firms making or proposing to make artificial silk in 1924 as well as prices of 1st, 2nd, and 3rd grade artificial silks in America in 1925. Finally, an excellent collection of the literature on artificial silk is given. The book is entirely different in construction from that of Suvern, which is mainly a collection of patent literature, but that under notice must be regarded as the most valuable book available at the present time. W.H.

The Chemists' Year Book, 1926. Edited by F. W. Atack (Manchester: Sherratt & Hughes, 21s. net).

The eleventh edition of this very useful reference book contains, in addition to the usual articles of various phases of industrial chemistry, a new section on lubricants, the matter for which has been supplied by Mr. H. Moore. This section might advantageously have been given a little more space, as it is incomplete in many respects, notably for instance, in that no mention whatsoever is made therein of graphite. The general arrangement follows the style of past editions, but all sections have been revised, and some enlarged. In this connection it might be remarked that the section on cellulose, very ably compiled by Mr. C. F. Cross, should be extended to cover the technically important modifications of cellulose, the artificial silks, to which very few lines indeed are devoted in the present edition. On the whole, the Year Book has maintained the standard of improvement set by the early editions, and is a reference work without which few chemists would care to be. —J.E.F.

THE JOURNAL OF THE TEXTILE INSTITUTE

Vol. XVII JULY 1926 No. 7

PROCEEDINGS

NOTES AND NOTICES

Council of the Institute

Although there was a lengthy programme of matters to be dealt with at the meeting of the Council of the Institute on Wednesday, 21st July, nevertheless the business was transacted with commendable dispatch. Unfortunately, the President (Mr. W. Howarth, J.P.) owing to a business engagement in London was unable to attend, whilst Mr. John Crompton (Chairman) was also unable to be present. Mr. W. Frost (Macclesfield) was voted to the Chair, and others present were Messrs. T. Fletcher Robinson, F. Nasmith, J. C. Withers, H. P. Greg, W. W. L. Lishman, W. Kershaw, A. B. Shearer, E. A. Swift, H. Binns, S. Watson, C. S. Ickringill, H. Nisbet; and the General Secretary. The correspondence, dealt with at the outset, included a letter from the Federation of British Industries asking the Council to furnish information as to technical education in reference to the textile industry, a questionnaire being submitted in connection with the demand. It was decided to refer the matter to the Selection Committee. A letter from Mr. W. Harrison suggesting expansion as to both activities and premises of the Institute was referred to the Propaganda Committee. Mr. J. H. Lester wrote suggesting that the Council might usefully consider the question of re-forming the General Purposes Committee, abandoned some time ago, and it was agreed that this question be placed on the agenda for the next meeting. The appointment of standing committees of the Institute was dealt with in accordance with recommendations of a special meeting of chairmen of committees, and the proposals of certain of the committees concerned. The names of the committees, it may be expected, will be published in the next issue of this *Journal*. There were seven elections to membership and, in this connection, the Council approved of a new form of application for membership of the Institute, the form providing for considerable additional information to be supplied by applicants. The Hon. Treasurer (Mr. T. Fletcher Robinson) submitted the financial statement which indicated that the balance at bank on current account would be small after payment of accounts to date. The Finance Committee had met that morning and recommended a policy of conservation with regard to income from Diploma fees and Life Membership subscriptions. The Council readily approved of the recommendation that the balance in favour of the diplomas account at the end of the present financial year be invested in War Stock, and that a similar course be pursued with reference to all new subscriptions for Life Membership on and after 1st January next. It was agreed that the General Secretary should visit Belfast in September in order to carry out the suggestions of Professor Bradbury and Mr. F. Anderson (Portadown) regarding reorganisation of the Section for the Belfast district. The Annual Conference of the Institute

which was postponed from Whit-week last is to be held, if possible, about the third week in October, and the General Secretary was asked to take steps to ascertain how far the original programme could now be carried out. It was decided that next meeting take place at the usual time—2.45 p.m.—at the Institute's head-quarters on Wednesday, the 22nd September, no meeting to take place during the month of August.

Applications for Appointments

Employer-members of this Institute are making increasing use of the services of the Institute in regard to the securing of suitable candidates for vacancies in employment. Conversely, members in pursuit of occupation frequently register particulars of their claims for consideration in connection with vacancies. Many cases might be recorded wherein the services of the Institute have proved of mutual advantage to both employer and employee. The complaint has been made that the textile industry does not readily absorb all those young men who have submitted to a prolonged period of special training and secured commensurate qualifications, but it might be useful to suggest that more attention on the part of the applicant for engagement should be given to the manner in which he approaches the industry. The experience of the secretarial department of the Institute in reference to applications for vacancies received at the Institute for forwarding to the employer, has, in several instances proved disappointing. Applicants have submitted applications prepared in a perfunctory manner, with the records of experience set out without the slightest regard for order of presentation. In one instance, recently, an application was returned with the suggestion that better paper should be used and that either the handwriting should be more legible or typewriting resorted to. If applicants are not at least reasonably painstaking in the preparation of their applications, then they must not complain if their efforts prove futile.

Section Committee Meetings

Arrangements are proceeding with reference to the promotion of Section meetings for the delivery of papers, followed by discussions, during the coming Autumn and Winter months. The Yorkshire Section has already announced its intention of holding meetings at Bradford, Keighley, Batley, Huddersfield, and Halifax, and it is intended to secure as far as possible the co-operation of local textile societies in the promotion of the meetings. The President of the Institute (Mr. W. Howarth, J.P.) has kindly promised to address a meeting at Bradford, and this event will take place jointly with the Bradford Textile Society, whilst members of the Shipley Textile Society are to be invited to attend. The Lancashire Section Committee of the Institute has already held one useful preliminary meeting in reference to its programme for next session. It is proposed to hold a series of luncheon meetings at which short addresses will be given dealing with various aspects of the textile industries of foreign countries. It is also proposed to hold meetings in Macclesfield, Preston, and Leicester during the session. In the early part of next year, Sir W. H. Himbury, of the British Cotton Growing Association, will contribute a paper at Manchester on the subject of Empire cotton supplies. It is also proposed to endeavour to reconstruct the Northern Ireland Section of the Institute, whilst in Scotland one or two meetings are contemplated, an arrangement having already been reached for a paper to be given at Dunfermline in the latter part of the year.

Fellowships and Associateships

Up to the present time, the announcements of the grant of Institute Diplomas to its members represent the issue of 80 certificates of admission to Fellowship and 52 of admission to Associateship. So far, the Selection Committee of the Institute has had a difficult and exacting task to perform. From the outset,

it was recognised that in the early stages it was not advisable to set up definite or binding regulations. The Committee preferred to be guided by experience in dealing with early applications. It is interesting to note, however, that the stage has now been reached at which the Committee is taking steps in the direction of the formulation of regulations to be rigidly adhered to in the case of future applications. In due course, doubtless, some announcement will be issued by the Committee, and a date subsequent to which new regulations will be rigidly adhered to may be fixed. Already, one examination of candidates has taken place (candidates for Associateship) and a similar examination is to be held in September. In due course, however, it is hoped to frame a syllabus indicating the requirements of the Committee, and a meeting will be held at a comparatively early date for the special purpose of giving full consideration to the provisions of the proposed syllabus.

Design and Structure of Woven Fabrics

Under the Lieutenant Crompton Memorial Scheme, this Institute is enabled to offer annual awards of over £100 in prizes with a view to the improvement of design, colour, and structure of woven fabrics. It is felt that a scheme of this kind might be of far greater service to the industry if more definite and direct interest on the part of manufacturing and other interests were secured. Suggestions with a view to modification and improvement of the existing scheme of competition have recently been submitted to the Committee of the Institute in charge of the scheme. In order that details of the scheme may be fully considered, it has been decided to hold a conference of the Committee and of representatives of various textile organisations and technical colleges and schools at the Institute, at Manchester, on the afternoon of Saturday, 11th September. The funds available for the scheme are quite adequate for the purpose, and additional co-operation is desired solely in order that the utmost advantage may be secured by the operation of the scheme. It is confidently hoped that as a result of the Conference the details of the annual competitions may be considerably improved. It may be mentioned that since the scheme was put into operation a few years ago, several revisions of the prospectus have been carried out. Whilst the quality of the productions of the competitors has definitely improved, yet the number of competitors secured each year is usually not so large as should be the case in a competition offering such substantial rewards to the successful participants.

Diplomas of The Textile Institute
Awards of Fellowships and Associateships

FELLOWS

BERRY, Frank (Bolton).
BROADBENT, James Thomas (New York).
BROMILY, Harold (Cloughfold, near Manchester).
VERNON, William (Cawnpore, India).
WILKINSON, William (Blackburn).

ASSOCIATES

ADAN, John McKay (Aberdeen).
BOSWELL, William Ernest (Nottingham).
CHRISTIE, David Robert (Galashiels).
DEY, J. Nath (India).
GOULDING, John (Woolfold, Bury).
HARTLEY, Hiram (Potternewton, near Leeds).

Elected to Institute Membership

At the July issue of the Council, the following were elected to membership of the Institute—A. R. Baines (Woollen Manufacturer), Southfold, Morley, near

Leeds; S. E. Illingworth (Worsted Textile Manufacturer), Messrs. Thos. Priestley and Sons Ltd., Bank Top Mills, Great Horton, near Bradford; W. Lees (Spinner, Teacher of Textile Technology), 58 Osborne Street, Oldham; Herbert Nutter (Retired Manufacturer), Ash Lea, Bagslate, near Rochdale; R. S. Spreckley (Textile Designer), 34 Cowper Place, Bradford; John P. Twohig (Textile Designer and Technical Teacher), 163 Victoria Terrace, Undercliffe, Bradford; G. Waddington (Textile Student), Springfield, Haslingden, Rossendale.

Linen Industry Research Association

Dr. W. H. Gibson, O.B.E., F.I.C., F.Inst.P., has been appointed Director of Research for this Association in succession to Dr. J. Vargas Eyre. Dr. Gibson was educated at University College, London, under Professor Sir William Ramsay, and is Doctor of Science in Chemistry of London University. He spent twelve years at the Research Department, Royal Arsenal, Woolwich, and for his services in connection with high explosives research during the Great War was awarded the M.B.E. in 1918 and the O.B.E. in 1920. For the last seven years Dr. Gibson has held a responsible position in the linen industry, having been in charge of the research department of one of the most prominent linen firms in Belfast. Dr. Gibson is a member of the Textile Institute, and has frequently contributed to the Transactions Section of this journal.

COMMUNICATIONS

The following correspondence is published by the consent of the originator, Mr. G. J. Fleming, manager of the Kassala Cotton Co., Aroma, who agreed to this course in the hope that members of the Institute would contribute any information or suggestions they may have upon the matter. Other letters have been specifically sought and in most cases definitely promised, and it is intended to publish these with any that may be forthcoming as a result of publication, in later issues.—EDITOR.

To the Editor

Dear Sir,—I have for many years held the opinion that a very great development could take place in wool production in this country. I have advocated the advisability of introducing the merino sheep to cross with the existing native sheep but no progress has yet been made. I still live in hope, however. There is a certain amount of information which I require and with which I feel sure you could furnish me or at least could put me in the way of making further investigation. The position is this—A belt runs across the whole breadth of the Sudan and in this belt live a great number of sheep. The rainfall of this belt varies from 10-30 inches per annum and is confined to four months in the year. North of this line, there is not enough grazing; south of this line, the soil is too heavy and the sheep do not thrive. The following table gives the mean average yearly temperature taken over a period of 16-18 years in three towns in the sheep belt.

Temperature		Evaporation	Relative humidity
Maximum ° C.	Minimum ° C.	("Piche" scale)	(per cent.)
36·8	21·1	10·22	44
34·7	17·7	13·58	39
37·4	20·0	13·15	38

The average maximum monthly temperature rises to 41·9° C., while the average minimum can fall as low as 11° C.

The following peculiarities of the Sudan sheep should be noted—

(1) They have a very thin fleece and most of the fleece is composed of hair The fleece at present is not worth removing as a commercial product It is woven into very coarse coverings by some tribes.

(2) All the Sudan sheep have long legs, as they require to walk a great distance to water.

I wish to know if, under the circumstances, it is practical in the opinion of experts to import a wool type of sheep, who could stand these conditions of environment and climate. Owing to the heat and the great distances they require to graze over in order to gain their existence, it is impossible to expect sheep in this country to carry large fleeces. I am sanguine enough to hope, however, that it may be possible to breed a sheep—the fleece of which will at least be worth shearing and exporting. If the proper sheep can be bred, it means that the improvement of sheep husbandry from the Red Sea to Lake Chad is in sight and will affect several thousands of flocks.

(Signed) G. J. FLEMING *Manager*
Kassala Cotton Co. Ltd.

Aroma, Sudan, *6th April* 1926.

To the Editor

Dear Sir,—My reply to Mr. Fleming's letter is as follows—

(1) The average rainfall per annum is probably not an important figure, but 10″—30″ per annum, properly distributed, might be reasonably satisfactory.

(2) The distribution of the rainfall is the important matter, as even the Australians recognise. It seems to me, therefore, that the whole of the rainfall being confined to four months in the year makes the proposition of introducing further types of developed sheep problematical.

(3) The temperature difficulty can almost certainly be met by providing the correct type of animal.

(4) It would seem very desirable to maintain certain characteristics of the Sudan sheep, particularly

(*a*) The long legs to enable it to travel; and

(*b*) A large body, by the cubicle contents of which moisture, &c., may be better retained than by a small body.

What is the critical volume for a sheep in this part of the country can only probably be worked out by breeding experiments.

(5) The food conditions would suggest a desert acclimatised Australian or South African merino, but great care would have to be exercised in selecting for type, otherwise the unfortunate experience of Australia with the Vermont merino during the great drought might be repeated.

If Colonel Stordy were to recommend the trial of the Peruvian merino, it might be possible to get examples from the stud flock in this country at Reading College.

(Signed) ALDRED F. BARKER
Professor of Textiles.

Department of Textile Industries,
The University, Leeds,
26th April 1926.

To the Editor

Dear Sir,—Many thanks for your letter enclosing a copy of Mr. Fleming's original letter. I am afraid that we in this Department have no special knowledge of the problem involved and can only give you some general impressions

First, with regard to climate, there would seem to be no reason why strains of Merinos should not be found that would be suitable for the hot, dry climate. South Australia and Arizona occur to one in this connection. The Merinos that are bred in the former area are large and well calculated to resist drought. Professor L. J. Cole, of the University of Wisconsin, should be able to provide valuable information upon analogous conditions in America. If a small flock of suitable Merinos were imported into the Sudan, they could be observed as a pure flock, and the result of hybridisation with the native sheep could be investigated. It

would be necessary to secure as much information as possible before selecting the type considered likely to be suitable, but the matter could only be settled by direct experiment.

Secondly, I am doubtful about the importance of long legs. This may be necessary, but need not, I think, be taken for granted until the point is tested.

Thirdly, a point that may be a deciding factor is the question of parasites, both external and internal. This can only be settled by experiment. It would be seen whether a pure Merino flock flourished or was badly affected. If they were found to be very susceptible, an attempt would have to be made to preserve in the grading-up process the natural relative immunity of the native stocks.

I should imagine that the Peruvian sheep would be a doubtful proposition owing to the fact that their habitat is at a very great elevation above sea-level and the rainfall is not low. The first step should be to obtain first hand information of the breeding of Merinos in those areas where the physical conditions most closely resemble those obtaining in the Sudan.

(Signed) J. A. F. ROBERTS.

Animal Breeding Research Department,
University of Edinburgh,
King's Buildings, Edinburgh,
24th May 1926.

To G. J. Fleming Esq., Kassala Cotton Co. Ltd., Aroma, Sudan.

Dear Sir,—Mr. Hugh L. Robinson, Editor of the *Journal of the Textile Institute*, has forwarded to me your inquiry in regard to the advisability of introducing improved breeds of sheep into the Sudan. I fear my personal knowledge of the conditions, as well as of the breeds of sheep, is so limited that I cannot give you specific advice. I am accordingly taking the liberty of forwarding your letter and Mr. Robinson's request to our Federal Department of Agriculture. I think our experts in sheep husbandry in the Animal Husbandry Division of the Bureau of Animal Industry can, perhaps, from their wide experience with breeds and conditions in this country, give you suggestions that may be of value.

As to the methods of breeding to be employed after improved sheep have been introduced, several different ones are possible and what would be best to employ will depend largely upon local conditions.

First, if an established breed can be found having the desired qualities and able to meet the climatic conditions, the simplest method is, of course, simply to continue to breed it as a pure breed which should gradually supplant and replace the native unimproved sheep. I doubt whether pure bred Merinos would thrive under the conditions, but if they were to be tried I would suggest the Rambouillet as perhaps being better suited than the other types.

Second, another method would be to introduce a suitable improved type and use the males for breeding on native ewes, thus gradually grading the stock up toward the improved breed. This method, like the first, would be suitable only in case the improved breed were one adapted to the conditions of the country.

Third, it is quite possible that the crossbred sheep obtained from breeding the improved rams on native ewes would be superior in quality to the native sheep and at the same time would be hardier and better adapted to conditions than the pure bred improved type. This might indicate the desirability of a continued system of cross-breeding, the details of which would have to be worked out according to circumstances. In some of our western states, for example, it is a common practice to alternate the use of Rambouillet and Hampshire rams on what are called the native "western ewes." By this means a balance is maintained in quality of wool, mutton type, and herding instincts which gives a sheep better than either of the pure breds used. It is quite possible that some

such system as this would work out to best advantage in your country, but just what crosses would give the best results would probably have to be determined to considerable extent from trial.

I trust that you may receive some suggestions of value from Washington.

(Signed) L. J. COLE
Professor of Genetics.

University of Wisconsin,
Madison, Wis., U.S.A.,
16*th June* 1926.

REVIEWS

Les Tissues Impermeables. By D. de Prat. Second edition. Published by Libraire Polytechnique Ch. Béranger, Paris.

The book is divided into two sections—the first dealing with waterproof fabrics and the second with fabrics impermeable to gases such as are required for balloons, &c. A description is given of the methods of rubbering fabrics; of the waterproofing of fabrics with aluminium acetate; with aluminium soaps, more particularly aluminium oleate; with copper salts, particularly Schweitzer's reagent as used in the Willesden process, and, finally, with other metallic compounds such as the oxides of antimony, tin, lead, and zinc. The methods of waterproofing with paraffin wax applied in liquid form and in solution are described, following which processes using gelatin, glue, tannin, gelatin bichromate, calcium caseinate, albumen, solutions of cellulose, &c., are dealt with. Chapter IV. deals with various methods requiring the use of metallic salts, soaps, silicates, gelatine, gums, drying oils, rubber, and cellulose compounds. An account is given of the application of electricity in the waterproofing of fabrics with aluminium oleate. The aluminium oleate formed in the fibre by impregnation with a soap solution, followed by a solution of aluminium sulphate, is subjected to electrolysis whereby the aluminium oleate is said to be converted into a basic oleate insoluble in benzine and other solvents used in dry cleaning. Various methods are given for the determination of the resistance of waterproofed fabrics to air, light and air, washing, use, and perspiration. Appendices are given dealing with tarpaulins, and such fabrics as taffetas, moleskins, &c. In considering fabrics impermeable to air, the treatment of aeroplane fabrics with agar-agar and formaldehyde, followed by collodion, is described, also the use of cellulose acetate. Methods of preparing balloon envelopes from cotton, silk, and linen by treatment with varnishes containing linseed oil, guttapercha, rubber, &c., are given, but the main part deals with rubbered fabrics. Methods for determining the impermeability to air, hydrogen, &c., are described. W.H.

Chemistry and Practice of Finishing. By Percy Bean and W. McCleary. Published by Hutton, Hartley & Co. Ltd., Manchester. (2 vols., pp. 624 and 396. Price, 60s.)

The third edition of this well-known work has been carefully revised and considerable new matter incorporated, thus bringing it up to date and rendering it not only suitable for students and apprentices, but useful as a work of reference to the practical finisher. Its value is not confined to those intimately bound up with the finishing trade but it will appeal to a wide circle embracing many who are only indirectly interested since finishing is only one link in the textile chain.

The first volume deals lucidly with the practical bleaching of cotton and linen fabrics and the materials used in the finishing of either. It also deals with the method of analysis of such materials in a manner readily understandable by those whose knowledge of chemistry is somewhat limited. Photo-micrographs by Mr. A. Flatters, and an account of the main textile fibres form an interesting introduction to the chapters dealing with the various chemicals used in bleaching. The question of the quality of the water used in textile processes is also adequately dealt with. The whole may be profitably digested by the practical bleacher. The chapters dealing with the important problems arising out of the bleaching of cotton goods containing artificial silk and of cotton fabrics containing coloured yarn are well written. There are certainly difficulties to be overcome in treating

goods under both the above headings. It is necessary to emphasise that many of the troubles which arise in bleaching these fabrics are due to ignorance and carelessness preparatory to the goods being bleached. Comment might have been made on the difficulties experienced by the bleacher from the indiscriminate use of mixed brands of artificial silk which is comparable to the trouble repeatedly found in cotton fabrics made from indifferent mixings. The chapter dealing with machinery is comprehensive and well illustrated; the essential principles being adequately defined. The three closing chapters of the first volume deal very fully with the questions of stains and faults in cotton fabrics and will merit thorough digestion by all employed in the textile industry. Part 2 is devoted to an account of the substances used in finishing and conveys some idea of the complexity of the intricate processes necessary to enhance the value of an ordinary piece of woven cotton fabric.

The second volume gives a fairly complete account of the finishing of cotton goods. The necessary machinery is described, and in addition a number of patterns are given showing various finishes. Taking into consideration that present-day finishes are numbered by the thousand, the patterns here displayed are fairly representative and must be useful to those in the industry who are responsible for this branch. Apart from a few paragraphs—e.g., page 132 on "Carbonyl Chloride," and page 151 on "The Use of Liquid Chlorine" ("writ sarcastic") no serious criticism is offered and the work will meet with appreciation by all interested directly or indirectly in the bleaching and finishing industry.

—W.K.

La Ramie. Culture et Succédanés. By Felicien Michotte. (Soc. de propagande coloniale, 45 Avenue Trudaine, Paris. Tome 1[er], 158 pp. and Index. 10s. net.)
At the conclusion of the preface of the first edition of his now well-known work, published in 1890, the author stated "Ramie is the textile fibre of to-morrow." While it is highly improbable that the material will ever satisfactorily replace the staple vegetable fibres in common use, there is no doubt that extended utilisation of ramie in the textile industries merits further consideration, and one therefore welcomes publications on the subject. The present monograph represents a re-edited and amplified version of a part of the first edition. It would have been enhanced by the omission of the early portion, in which the author replies to the criticisms of his earlier work. A brief account of the external and internal morphology of China grass, and a description of the animal parasites attacking the plant are given and are followed by an exhaustive treatment of its cultivation, and of processes for recovering the fibre employed in various parts of the world. The writer pays special attention to decortication methods, having devised a machine for the purpose. Dealing as it does in detail with the geographical distribution and culture of ramie and of allied members of the *Urticaceæ* family, the present volume will be of greater interest to the economic botanist and tropical agriculturist than to the textile technologist. —F.L.B.

Shirley Institute Memoirs. Vol. IV., 1925. Shirley Institute, Didsbury, Manchester.
Those in the process of forming scientific and technological libraries will welcome the appearance of the fourth volume of the Shirley Institute Memoirs, in that one obtains in collected form the non-confidential researches published by members of the staff of the British Cotton Industry Research Association in this *Journal* during the past year. Altogether, fifteen papers are presented; they deal with problems connected with the chemical constituents of the cotton hair, with spinning, sizing, mercerising, and dyeing. Details of investigations into common faults in cotton goods and the development of fungal growth in sizing materials employed in the cotton industry also appear. Papers of special value to those interested in colloids generally have been contributed by A. R. Urquhart and A. M. Williams (the brilliant physical chemist whose recent death is to be greatly deplored) and by F. D. Farrow and S. M. Neale. In every case, the researches have been carefully and exhaustively carried out, and considerable energy has been justifiably expended in the "writing up" of results. It is of course impossible in many cases to translate a scientific paper into language understandable by the average layman, but the summaries provided should enable those with no scientific knowledge to obtain a reasonably good grasp of the results obtained. —F.L.B.

Cloths and the Cloth Trade. By J. A. Hunter. Published by Sir Isaac Pitman and Sons Ltd., London. (pp. 116, price 3s. net.)

A book of interesting matter which ought to be read by all who are engaged in the merchanting of the different kinds of fabrics. Chapter 4 (Cloth-making Materials) is exceedingly good and is by far the best in the book. In the last chapter, page 82, the author, whilst dealing with the cloth warehouse might have included the various types of "make-ups" and the markets for which they are intended. On page 64, Blackburn is mentioned as making fine fancy cottons, it is noted more especially for dhooties; whilst Nelson and Colne make every type of cotton cloth (with a few exceptions) and are principally noted for coloured dress goods, as indeed the author states. Common names are given on page 66, and the author would have been well advised to explain what he meant by "plain surfaces are produced by other than plain weaves." If the author's statement that common twills "are included by most people in the category of plains" is correct, it is safe to say that "most people" have a poor understanding of cloth analysis. It is a bold statement to make (page 67) that it is impossible to decide where the one class of fabrics ends and the other begins. The next paragraph gives several names of plain woven cotton cloths, and further on the point is raised at which a drill tails off into a drillette, or a jean into a jeanette. In the trade a drill is understood as either a four or five-shaft weave, and the yarns are much heavier than in drillettes, hence we have Florentine drills, and satin drills. A drillette is a five-shaft weave and of much lighter yarns, with a preponderance of warp threads. Jeans are three-shaft twill weaves and ought to have more warp than weft, a jeanette ought to have more weft than warp, and is a much lighter cloth. But despite these criticisms, which are made in the hope of aiding a revision of the book, this addition to the "Common Commodities" series is a useful one and will be very welcome. —W.H.

The "Electrician" Annual Tables of Electricity Undertakings, 1925. Published by Benn Bros. Ltd., London. (189 pp., 10s. net, postage 9d. extra.)

An increase of 20 pages on last year's edition of these tables is due to the inclusion of particulars of many electrical undertakings which have not appeared previously. There are now statistics relating to more than 800 British and over 1,300 Colonial and Foreign concerns; all essential details being given in each case of system employed, maximum load, generating plant, price per unit, &c., together with additional information likely to be of use to engineers, manufacturers, and contractors in the electrical industry. It is difficult to understand how this book, upon which so much careful work has been obviously expended, can be sold so cheaply. —J.E.F.

Chimie et Industrie. 1914-1924*. Ten Years' Progress in Science and Industry. By various authors. Edited by Jean Gérard. Published by Soc. de Chimie Industrielle, Paris. (1,552 pp. and Index.)

The book is divided into sections dealing with ten years' progress in the various branches. General chemistry is dealt with by G. Urbain recording progress in thermo-chemistry, chemical affinity, the law of mass action and the phase rule, as well as the principle of Nernst; nothing very remarkable is recorded. Organic chemistry is written of by A. Béhal. The war is said to have hindred developments in this section and no great progress is recorded. Dealing with biochemistry, A. Desgrez mentions considerable progress in catalytic and enzyme chemistry, the constitution of proteins and hormones, and of nutrition in general. In agricultural chemistry, L. Lindet deals with progress in soil chemistry and the effect of various bacteria in soil, and refers to fatigue in soil produced by toxins.

A discussion of general conditions of scientific research in France, by Ch. Moureu, deals with the role of science during the war, science in the country, and science in industry, and mentions the organisation of scientific work in France. In a paper on analytical chemistry, A. Kling mentions new organic reagents, electrolytic and spectroscopic methods of analysis, and deals with X-ray methods of crystal analysis as well as with the application of positive rays. While M. Dienert, in an article on water, describes various methods and apparatus

* Reference was made in this *Journal* to the book reviewed above in the April 1925 issue. So far only one volume has been received; the second is in hand and notice of it will be published as soon as received—Editor.

for filtering and purifying water by physical and chemical methods, sterilisation by ultra-violet rays and chemical methods, and treatment of sewage. The three papers above referred to form part of a series dealing with scientific and technical progress in chemistry. It would be impossible in the space available to enumerate all the articles in this or the following section "L'Effort Industriel," but mention of some of the articles of more direct interest to textile technologists will serve to indicate the scope of the work. E. Audibert deals with oils; A. Baril writes on the carbonisation of oils at low temperatures; E. Damour treats with the rational utilisation of combustibles; L. Pierron discusses sulphuric acid and phosphates; A. Wahl takes for his subject colouring matters; photographic products, embracing colour sensitisation, are dealt with by A. Seyewetz; colours, lacs, varnishes, and printing materials form the subject of Ch. Coffignier's contribution; observations on latex are made in an article on rubber by R. Fric; R. Padova and E. Bontoux deal with modern work on oils and soaps; R. Auzenat writes on artificial textiles, giving a short account of progress in the well-known types; while bleaching, dyeing, printing, and finishing of textiles, including artificial silk are treated by Ch. Sunder.

In L'Effort Industriel section, interesting articles are contributed by H. de Peyerimhoff on oils; by V. Barut on electrochemistry; by J. de Kap Herr on colouring matters; by E. Roustan on soaps; by E. Carnot on artificial fibres; by H. Lagache on natural fibres and the dyeing industry; by A. Gardinier on alcohol; and by H. Hitier on agriculture.

The book is mainly an encyclopædia of modern developments and it is difficult for any reviewer to express an opinion as to its value. It is, however, a useful book of reference particularly dealing with developments in France. In most cases a good list of references is given. Individual members of the Institute would do well to refer to this book on their own subjects. A word of hearty praise for the typography and binding of the volume, which is nearly 2½ inches thick, must be added; it is as near perfection as may be in the manner in which it can be opened and laid flat at any page —W.H.

GENERAL ITEMS AND REPORTS

A Statistical Analysis of Cotton Prices for the Period 1892-1923

By Dr. Gustav Harting

(The Institute for Mathematical Statistics, Göttingen; Director, Prof. Dr. Felix Bernstein)

Translated and abridged, with the author's approval, by G. L. Schwarz, B.Sc., of the London School of Economics, from *Leipziger Monatschrift für Textil-industrie*, Sonder Nummer No. 3, September 1924; and *Leipziger Wochenschrift für Textil-industrie*, Nos. 47-49, November-December 1924.

In these articles detailed analyses are made of the statistical data for American cotton during the period 1892-1913, and 1913-1923, and from the results of the analyses, methods are suggested for forecasting future prices and movements. The various price-determining factors are examined in succession, dealing first with long period movements and working down to short-time fluctuations. A few definitions given by Dr. Harting must be first set out in order to make clear the method of investigation.

Any analysis of prices must of course deal with the figures for acreage under cultivation, yield per acre, total of harvest, and the prices themselves. In each case Dr. Harting uses the average of two years' figures to obtain what he calls the "normal," e.g.,

Average yearly price for two years	=Normal price.
Average yearly harvest for two years	=Normal harvest.
Average area under cultivation for two years	=Normal area of cultivation.
Average yield per acre for two years	=Normal yield.

The definitions will be quite clear if the tables are consulted.

The first analysis is concerned with the general tendency of prices over the 21 years, 1892–1913. The movement was downwards from 1892 to 1898, and

Table I. (No. vii. in original article)

Year	Harvest (in thousands of bales)	Normal Harvest (in thousands of bales)	Average Price in Cents	Normal Price in Cents	Difference between one harvest and the next		Difference between one average price and the next		Difference of two Harvests as % of the Normal Harvest		Difference of two Average Prices as % of the Normal Price		Deviations (12–13) (10–11)	
					+	−	+	−	+	−	+	−	+	−
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1892	6,658	—	8,4	—	—	—	—	—	—	—	—	—	—	—
1893	7,433	7,045	7,5	7,95	775	—	—	0,9	—	—	—	—	—	—
1894	10,026	8,728	5,9	6,70	1593	—	—	1,6	22,6	—	—	20,1	—	2,5
1895	7,147	8,586	8,2	7,05	—	2879	2,3	—	—	33,0	34,3	—	1,3	—
1896	8,516	7,831	7,3	7,75	1369	—	—	0,9	15,9	—	—	14,7	—	1,2
1897	10,985	9,750	5,6	6,45	2469	—	—	1,7	31,5	—	—	21,9	—	9,6
1898	11,435	11,210	4,9	5,25	451	—	—	0,7	4,6	—	—	10,9	6,3	—
1899	9,345	10,390	7,6	6,25	—	2090	2,7	—	—	18,6	51,4	—	32,8	—
1900	10,123	10,234	9,3	8,45	778	—	1,7	—	7,5	—	27,2	—	34,7	—
1901	9,510	9,816	8,1	8,70	—	6,03	—	1,2	—	6,0	—	14,2	—	20,2
1902	10,630	10,070	8,2	8,15	1120	—	0,1	—	11,4	—	1,1	—	12,5	—
1903	9,851	10,240	12,2	10,20	—	779	4,0	—	—	7,7	49,1	—	41,4	—
1904	13,438	11,644	8,7	10,45	3587	—	—	3,5	35,0	—	—	34,3	—	0,7
1905	10,575	12,006	10,9	9,80	—	2863	2,2	—	—	24,6	21,1	—	—	3,5
1906	13,274	11,974	10,0	10,45	2699	—	—	0,9	22,5	—	—	9,2	—	13,3
1907	11,107	12,190	11,5	10,75	—	2167	1,5	—	—	18,1	14,4	—	—	3,7
1908	13,242	12,174	9,2	10,35	2135	—	—	2,3	17,5	—	—	21,4	3,9	—
1909	10,005	11,623	14,3	11,75	—	3237	5,1	—	—	26,6	49,3	—	22,7	—
1910	11,609	10,807	14,0	14,15	1604	—	—	0,3	12,8	—	—	2,6	—	10,2
1911	15,693	13,651	9,6	11,80	4084	—	—	4,4	33,4	—	—	31,1	—	2,3
1912	13,703	14,698	11,5	10,55	—	1990	1,9	—	—	14,6	16,1	—	1,5	—
1913	14,156	13,929	12,5	12,00	453	—	1,0	—	3,1	—	9,5	—	12,6	—

from that time rose steadily till the end of the period. Not much statistical information is available for costs of production of cotton during the period, but a curve representing cost of production constructed from the few figures obtainable moves parallel with the curve for normal prices over the whole period except for the years 1901-1905. The movements of demand and supply are contrasted over the period. Demand is represented by the number of spindles in existence and supply by the production in bales. Parallel growth is again evident except for the years 1901-1905. The explanation of the discrepancy between cost of production and normal price and between supply and demand in 1901-1905 is, of course, the influence of the operations of the Sully corner.

The general movement in cotton prices over the period is also connected with the production of gold during those years and parallel movements are shown of cotton prices not only with gold production figures but also with the gold holdings of the banks of the Great Powers. This part of the analysis is, of course, applicable to the movement of general prices and is not confined to cotton.

The next section of the analysis deals with movements of individual years and treats cotton prices as a function of harvest results. The cotton harvest figures are compared with prices in order to find how far anti-parallelism exists between the curve for harvests and that for prices, i.e., whether prices rise or fall proportionately to the decrease or increase of the harvest.

The calculation is made by correlating the normal harvest figures with normal price figures, as is shown in Table I.

In estimating the results obtained in columns 14 and 15, any deviation less than 5% is considered to establish anti-parallelism between price and harvest. Such years are called symmetrical years. Where the percentage deviation is more than five, the anti-parallelism is not complete. Years when this occurs are called asymmetrical years (e.g., 1894, 1895, 1896, 1904, 1905, 1907, 1908, 1911, and 1912 were symmetrical years and only in half of the period under review was there complete anti-parallelism between the harvest and price curves. Explanations of the lack of correlation in the asymmetrical are given as follows—

1898—Comparatively favourable harvest and bear speculation. Failure of bull speculation based on incorrect estimates of the effect of the Spanish-American war. Prices fell below cost of production.

1899—Effects of farmers' protection policy. Beginning of Sully's corner.

1900—Sully corner taking effect.

1901—English spinners on short time as protective measure. Relieved prices temporarily.

1902—Sully corner dominated situation.

1903—Record prices.

1904—Record harvest. Systematic short time in Lancashire. Collapse of corner.

1906—Farmers' Union took active measures to prevent fall in price.

1909, 1910 } Patten and Scales attempt to corner.

The conclusion of this part of the investigation is that, apart from disturbing factors of the kind enumerated above, the tendency is for the price of cotton to rise or fall as much per cent. on the normal price as the harvest falls or rises on the normal harvest.

On the basis of this result an attempt can be made to estimate the price of cotton for the forthcoming year. Six factors are involved—

1—The harvest	for the first year	4—Normal price	for the next year.
2—Price		5—Harvest	
3—Normal harvest		6—Price	

The first four figures are available and experience has shown that a fairly accurate estimate of the forthcoming harvest can be made very early in the year. We are then in a position to calculate the price for the second year.

A simple example will illustrate the method of calculation—

In year X let	Normal Harvest	(NH_1)	$=10$
	Normal Price	(NP_1)	$=8$
	Harvest	(H_1)	$=11$
	Price	(P_1)	$=7$

Then in year $(X+1)$ if the Harvest $(H_2) = 12$, the increase as a percentage of the normal harvest is—

$$\frac{H_2 - H_1}{NH_1} = \frac{12 - 11}{10} = 10\%$$

The new price (P_2) will be such that $\frac{P_1 - P}{NP_1}$ gives the same percentage.

$$\text{i.e., } \frac{7 - P_2}{8} = \frac{1}{10} \quad \therefore \quad P_2 = 6{\cdot}2.$$

If the harvest in year $(X+1)$ is taken as 9, then

$$\frac{H_1 - H_2}{NH_1} = \frac{11 - 9}{10} = \frac{1}{5} = 20\%$$

$$\therefore \quad \frac{P_2 - P_1}{NP_1} = \frac{P_2 - 7}{8} = \frac{1}{5} \quad \therefore \quad P_2 = 8{\cdot}6.$$

The theoretical price obtained in this way can be marked on a graph of cotton prices and joined by a straight line to the point representing the price of the previous year. The line joining the two points is called the tendency line and apart from any abnormal interferences, prices during the ensuing year will be in the neighbourhood of the tendency line.

Table II. shows the results obtained by the above methods.

Table II.—Calculation of the Probable Price

Year	Harvest in 1,000 bales	Difference of harvests in 1,000 bales	Normal harvest in 1,000 bales	Difference of harvests as % of normal harvest	Seasonal Average price in pence	Normal price in pence	Theoretical price in pence
1	2	3	4	5	6	7	8
1892	6,717	— 2,321	7,878	—	4·49	4·34	—
1893	7,527	+ 810	7,122	10·28	4·20	4·34	4·04
1894	9,893	+ 2,366	8,710	33·22	3·30	3·75	2·76
1895	7,162	— 2,731	8,527	31·35	4·27	3·78	4·48
1896	8,714	+ 1,552	7,938	18·20	4·11	4·19	3·58
1897	11,181	+ 2,467	9,947	31·08	3·52	3·81	2·81
1898	11,235	+ 54	11,208	0·54	3·26	3·39	3·50
1899	9,440	— 1,795	10,338	16·01	4·35	3·80	3·80
1900	10,425	+ 985	9,932	9·53	5·25	4·80	3·99
1901	10,701	+ 276	10,563	2·78	4·62	4·93	5·12
1902	10,758	+ 57	10,730	0·54	5·12	4·87	4·59
1903	10,124	— 634	10,441	5·90	6·77	5·94	5·41
1904	13,557	+ 3,433	11,840	32·88	4·84	5·81	4·82
1905	11,320	— 2,237	12,438	18·89	5·83	5·33	5·94
1906	13,550	+ 2,230	12,435	17·93	5·77	5·80	4·87
1907	11,582	— 1,968	12,566	15·83	5·98	5·87	6·70
1908	13,829	+ 2,247	12,706	18·07	5·19	5·58	4·92
1909	10,651	— 3,178	12,240	25·01	7·38	6·28	6·59
1910	12,132	+ 1,481	11,392	22·10	7·77	7·57	5·99
1911	16,043	+ 3,911	14,087	34·33	5·94	6·85	5·17
1912	14,129	— 1,914	14,086	13·59	6·59	6·26	6·87
1913	14,885	+ 756	14,507	5·01	7·18	6·88	6·28

To test the results a tabulation is made of the deviations from the tendency line of the price in each month of the 21 years, i.e., 252 prices. Of the 252 prices, 143 were above the tendency line and 109 below. The excess of the total above the line is explained by the fact that information and reports of a shortage in the harvest naturally come in earlier than in the case of an abundant harvest and therefore, action and speculation for a rise work over a longer period than for a fall.

Table III.—Fluctuations from the Tendency Line

RESULTS FOR 252 MONTHLY PRICES

Percentage under tendency point.

21–25	16–20	11–15	6–10	1–5
4	9	17	25	54

$\underbrace{\hspace{6em}}_{109}$

Percentage over tendency point.

1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	76–80
46	37	20	8	13	6	3	4	3	2	1

$\underbrace{\hspace{12em}}_{143}$

Further analysis of the results shows that 54+46, i.e., 100 prices were within 5% of the contemporary monthly point on the tendency line. A margin of 5% can fairly be allowed in the price of any article dealt with on exchange, and Dr. Harting calls all movements within 5% of the tendency line natural fluctuations, and all beyond 5%, unnatural fluctuations. The 5% margin can be regarded as a straight line running parallel on each side of the price tendency line. To anticipate the criticism that this margin might not be a straight line but a curved one, Dr. Harting tabulated the 252 fluctuations under the individual months of the year and found that the average fluctuation was practically the same for each month. That is to say, there is no seasonal variation between the different months and the margin must be regarded as a straight line.

Table IV. (ix. in original)

Distribution according to months of the fluctuations of the average—

MONTHLY PRICE FROM THE TENDENCY LINE

Year	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−	+	−
1893	12		7		7			2		7		1		1		1	6		7		7		3	
1894		6		5		4		0		0	5		7		8		13		2		1		5	
1895		20		20		19		13		9		9		11		7	3		9		2		1	
1896	4		4		3		6		6			1		3	11		21		28		19		12	
1897		4		4	1		8		12		16		20		14		22		14		6		10	
1898		10		7		5		1		0		1		4		7		10		14		14		13
1899		7		5		7		10		12		15		17		17		17		10		8		7
1900	15		28		41		39		34		29		44		37		79		40		34		33	
1901	4		2			7		14		21		15		15		3		14		14		20		14
1902		4		2	2		6		7		5		4		1		4		7		1		3	
1903		10		5		3		3	5		18		18		21		12		1		10		25	
1904	43		39		50		48		40		22		19		17		21		8		7			1
1905		21		21		20		21		19		12	6		3			1		5	1		3	
1906	3		0		2		7		9		8		10		2			1	21		12		12	
1907		5		4		4		4		4	10		9		10		4			7		13		3
1908		1		1		4		10		4	8		5		5			5		7		4		5
1909		4		5		8		5	1		0		10		10		11		15		17		21	
1910	6		7		10		11		14		15		15		23		18		23		24		30	
1911	29		1		3		9		27		21		12		5		9			8		7		6
1912		14		8		5		0		1		1	7		1			3		10		1		1
1913	1		1		1		2			1	1		0		1		12		15		14		10	
Average......	13		10		12		15		15		12		12		11		18		15		11		13	
		9		7		8		7		7		7		8		7		7		9		9		6

Unnatural fluctuations occur of course as the result of abnormal influences. Dr. Harting calls all price movements outside the boundary of natural fluctuations irregular rises and falls and the next step is to analyse such cases to see if anything can be discovered as to the duration and intensity of such movements.

Out of 124 irregular movements, 81 were irregular rises and 43 irregular falls, which again illustrates the fact that the forces making for a rise operate more frequently than those for a fall.

Table V. shows the result of the analysis of irregular rises and falls.

TABLE V.—Intensity, Duration, and Average Daily Movement of Irregular Rises

Rise 1*	Interval Price 2*	Rise as % of interval price 3	Duration of rise in days 4	Average Daily Rise 5	Rise 1	Interval Price 2	Rise as % of interval Price 3	Duration of rise in days 4	Average daily rise 5
36	259	13	15	2	1·76	6·84	25	21	8
33	269	12	6	5	0·84	6·66	12	10	8
13	252	7	18	1	0·41	6·07	6	7	6
54	302	17	24	2	0·69	5·83	11	10	7
72	291	25	36	2	0·48	5·73	8	17	2
142	348	40	56	2	0·89	5·35	16	14	6
22	309	7	23	1	0·76	5·25	14	14	5
25	299	8	21	1	0·34	5·80	6	13	2
29	263	11	58	1	0·43	5·73	7	12	3
4	254	1	2	2	0·68	7·47	9	62	1
4	255	1	3	1	0·42	8·45	6	21	2
5	246	2	3	1	0·97	6·69	14	33	3
21	227	9	35	1	1·32	5·54	24	32	4
4	215	1	1	4	0·73	5·59	13	40	1
6	196	3	2	3	3·24	5·65	57	76	4
3	192	1	2	1	0·62	6·45	10	52	5
4	187	2	2	2	0·54	6·52	8	66	1
12	292	4	8	1	0·69	6·16	11	11	6
15	304	4	7	2	1·79	6·46	28	96	1
13	295	4	5	2	0·52	6·73	8	19	2
16	292	5	6	2	0·44	6·90	6	1	44
9	279	3	6	1	0·49	6·88	7	3	16
12	267	4	9	1	0·09	6·04	1	1	9
5	283	1	6	1	0·05	5·33	—	1	5
2	273	—	3	1	0·25	5·68	4	2	12
9	272	2	7	1	0·11	5·75	1	4	3
5	269	1	6	1	0·06	5·83	1	1	6
4	202	1	5	1	0·03	6·08	—	1	3
4	201	1	3	1	0·15	6·15	2	2	7
5	302	1	2	2	0·09	6·19	1	2	4
11	302	3	5	2	0·07	6·08	1	3	1
6	300	2	2	5	0·11	6·07	1	3	3
2	300	—	1	2	0·21	5·85	3	6	3
3	300	—	1	2	0·24	5·82	4	2	12
5	300	1	3	1	0·13	5·79	2	3	4
8	309	2	2	4	0·10	5·69	1	1	10
5	309	1	3	1	0·06	5·68	1	1	6
3	309	—	3	1	0·05	5·63	—	1	5
16	310	5	7	2	0·13	5·58	2	4	3
3	310	—	2	1	0·17	6·53	2	2	8
—	—	—	—	—	0·18	6·24	2	14	1

*Columns 1 and 2=prices in 64ths of a penny.

Intensity, Duration, and Average Daily Movement of Irregular Falls

Fall in 64ths	Interval Price in 64ths	Fall as % of Interval Price	Duration of Fall	Average Daily Fall	Fall in 64ths	Interval Price in 64ths	Fall as % of interval Price	Duration of Fall	Average Daily Fall
1*	2*	3	4	5	1	2	3	4	5
26	237	11	72	1	1·49	5·25	28	24	6
56	250	15	51	1	0·68	5·97	11	21	3
56	345	16	62	1	0·38	5·44	6	9	4
25	338	6	12	1	0·74	6·08	12	63	1
8	210	3	8	1	0·22	5·40	4	6	3
2	260	—	1	2	0·07	5·51	1	2	3
3	266	1	2	1	0·05	5·54	—	2	2
6	270	2	4	1	0·12	5·67	2	2	6
7	269	2	6	1	0·10	6·15	1	1	10
7	256	2	4	1	0·03	6·13	—	1	3
3	211	1	3	1	0·12	6·17	1	2	6
5	211	2	4	1	0·09	6·18	1	2	4
3	242	1	2	1	0·05	5·66	—	1	5
5	212	2	3	2	0·20	5·46	3	3	2
3	211	2	8	1	0·20	5·00	3	2	20
6	206	1	3	1	0·03	4·94	—	1	3
4	265	5	4	3	0·06	4·85	1	1	6
3	270	2	3	2	0·12	4·74	2	2	6
14	273	1	2	1	0·07	4·72	1	4	1
0·70	6·77	10	27	2	0·08	5·96	1	2	4
0·21	5·59	3	32	1	0·15	5·74	2	5	3
0·48	6·96	6	15	3	—	—	—	—	—

*Columns 1 and 2=64ths of a penny.

A graph based on these figures shows that the mathematical probability of such movements is greater in the case of a rise than for a fall, that is to say, the probability that a falling price will extend to a given percentage is less than in the case of a rising price, e.g., the probability of an irregular rise to the extent of 2% beyond the natural interval is 0·66, for an irregular fall of 2% it is 0·6.

The table also shows that the supposition that the higher the price the greater the average daily price increase must be is not confirmed in actual practice. But although nothing remarkable can be said of the daily movements during an irregular rise or fall, analysis of the subsequent reactions from irregular rises and falls produces some interesting results.

It is found that, of the 81 irregular rises, in 69 cases the succeeding fall directly took the price within the limits of natural fluctuations and the same occurred in 41 cases of the 43 irregular falls. That is to say, the probability that an irregular rise will be followed by an uninterrupted fall to the limits of natural fluctuation is 0·85, and for an irregular fall 0·95.

Table V. is not a complete analysis of the period but it suggests that the average daily price movement during the reaction from an irregular rise or fall tends to be of the same extent as the average daily movement during the irregular rise or fall.

Summing up the results of this statistical analysis, Dr. Harting suggests that they will be found useful in actual practice. They may help the bull speculator to calculate the probable intensity and duration of a rise, and the bear speculator to foresee the time and the lowest point of a fall. For example, if the speculator is dealing with a fall following an irregular rise, he can reckon that in the majority of cases it will go within the limits of the natural fluctuation from the tendency line and also that the slope of the falling movement will correspond to the slope of the preceding irregular rise. The dealer should find the results of great value. He has to avoid buying at the maximum point of a rise, as he does not know when the price will be reached again. By the aid of the probability curve he can calculate beforehand the chance of finding a purchaser as the result of a further expected rise. If the probability of a further rise is very small he would do better to postpone purchasing until the inevitable fall after the rise and with the

TABLE VI. (xi. in original)

Rising Prices				Succeeding Fall		
Year	Rise in Points	Duration of Rise	Average Daily Rise	Fall in Points	Duration of Fall	Average Daily Fall
1897	18/64	18	1/64	70/64	80	1/64
1900	72/64	36	2/64	47/64	24	2/64
	142/64	56	3/64	148/64	42	4/64
1902	22/64	23	1/64	32/64	40	1/64
1904	41	7	6	48	7	7
1908	34	13	3	40	13	3
Falling Prices				**Succeeding Rise**		
Year	Fall in Points	Duration of Fall	Average Daily Fall	Rise in Points	Duration of Rise	Average Daily Rise
1898	26/64	72	0·4/64	26/64	96	0·3/64
1901	56/64	51	1/64	37/64	39	1/64
	56/64	62	1/64	32/64	34	1/64

help of the above calculations he can approximately reckon the level to which the price will drop. He can also calculate the time when the lowest point will be reached and in the meantime he can make his dispositions with much greater ease and certainty; an inestimable advantage from the commercial point of view.

Supposing, however, that he has been left with a stock after the price has commenced to fall. When can he expect to cover his loss ? He cannot hold the stock until the price is again reached since this costs too much in interest for capital outlay. The usual method of equalising matters is to purchase at a subsequently lower price and sell if possible at a middle price. This method of covering losses is dealt with in an investigation designed to answer the question—"Within what period will a certain price be again reached?" Dr. Harting has tabulated imaginary transactions at the highest price for each week of the 22 years and the length of time that elapsed in each case, before the price was again reached and the transaction could be completed without loss. Since in the case of rising prices the position is covered within a few days, Dr. Harting has ignored all periods less than one month.

The results for the 1,144 transactions involved are given in Table VII.

It will be seen that practically all transactions were covered within 18 months; in other words, apart from exceptionally high prices, it may be expected that any price will be reached again within 18 months.

Some explanation is needed of the fact that a price not touched by the fluctuations during a year should nevertheless be reached within 18 months. Dr. Harting's explanation is that if it is true that price is a function of the harves total it is also true that the harvest is a function of the price.

High prices make for increased harvest in the following season and *vice versa*. This might suggest that the harvest total is directly influenced by an increase or reduction of the acreage and cultivation. In this case the curves for harvest results and acreage under cultivation should show proportional movements. This correspondence does not appear on a chart except in times of extraordinary prices, and Dr. Harting suggests that the harvest total is influenced by more or less extensive cultivation on the part of the grower. High prices enable and encourage the grower to give more attention to the plant, to expend more on fertilisers, &c., and so to obtain an increased yield on the same area. That is to say, correspondence of movement is rather between yield per acre and harvest total and a graph of the movements of these two factors shows this to be the case. Of course, this theory does not explain everything, since the harvest is influenced by other factors. The weather during sowing and harvest time, or pests may

TABLE VII. (xii. in original)

DISTRIBUTION OF IMAGINARY TRANSACTIONS ACCORDING TO LENGTH OF COVERING PERIOD

Duration in Months	No. of Transactions Covered	% of Total Transactions	Duration in Months	No. of Transactions Covered	% of Total Transactions
1	671	59	23	—	—
2	127	70	24	3	95
3	65	76	25	5	96
4	47	·80	26	13	98
5	21	82	27	—	—
6	10	83	28	1	98
7	16	84	29	3	98
8	13	85	30	1	98
9	15	87	31	—	—
10	13	88	32	2	98
11	6	88	33	6	98
12	6	89	34	5	98
13	5	89	35	1	98
14	7	89	36	6	99
15	9	90	37	3	99
16	10	91	38	—	—
17	4	92	39	1	99
18	4	92	40	2	99
19	6	93	—	—	—
20	8	94	80	2	100
21	5	94	81	4	100
22	4	95	82	4	100

completely change the situation. In the years 1921-23 in spite of a record area under cultivation, the depredations of the boll-weevil resulted in a lower yield than in any of the previous ten years. Nevertheless it still remains true that 18 months is the extreme limit for the duration of a covering transaction. If we buy low the rise will certainly occur within the next year; if we buy high a falling movement will occur in the next twelve months, giving place to a rising movement which will reach the purchase price within eighteen months. In practice, of course, the long term transactions will not occur as frequently as in theory. The maximum result in risk-covering transactions will arise if stock is bought at the minimum point of fall. The statistical results enable us to estimate approximately the duration of a fall and there is no necessity to hold on to stocks bought at a high price. These can be marketed as soon as the fall sets in and interest saved on the capital, which can be employed in some other productive way until the calculated moment when prices will begin to turn upwards.

[In a subsequent issue Dr. Harting's analysis for the years 1913 onwards will be discussed—EDITOR.]

National Safety Council, Chicago, U.S.A.

We have received a most interesting set of papers from this Council and commend them to the attention of all mill men. Membership of the organisation is open to firms who subscribe according to the number of employees; for 600 to 3,000 operatives the scale ranges from 60 to 100 dollars. In return, the Council supplies posters, lantern slides, films, pamphlets on safe practices, a magazine, and advice. There is a special textile section which also holds meetings. The illustrated notes on "Safe Practices" are eminently reasonable and the warning posters are perfectly clear without being crude. We must confess that the American National Safety Council appears to be much more closely acquainted with the Textile Industries than any similar organisation. —J.C.W.

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PROCEEDINGS

London Section

Exhibition at Institute's London Rooms, in Bloomsbury Square, of Fabrics woven in Bradford Technical College under Bradford Textile Society's Prize Scheme, 23rd and 24th June 1926.

The chief objects of this exhibition were, firstly to illustrate the type of work being conducted by the Bradford Textile Society and the Bradford Technical College to develop colour and design as applied to woven fabrics, and secondly to obtain from London buyers of textiles, suggestions and constructive criticism so as to stimulate this section of work to a higher standard of attainment. The fabrics displayed were the results of students' experiments, produced under the Bradford Textile Society's Prize Scheme, and not the results of work of designers with industrial and factory experience. Of the 280 fabrics displayed, of which no two were alike in design and colouring, fully 60% were produced by young men who had not been employed in a weaving factory, but who, over the age of 16 years, had left a secondary, grammar or public school, and entered upon a three year course of full-time study in cloth manufacture at the Bradford Technical College. The objects of the scheme were to encourage experiments in new combinations of materials, the production of new effects due to twist and unusual structure of yarn, and to foster improvements in colour, design, and structure. The possibilities of artificial silk were illustrated by combinations of viscose and "Celanese" artificial silk, and also by combinations of artificial silk with wool, cotton, and pure silk. More than 20 various combinations, including piece-dyed two-colour effects, in these materials were displayed. One cloth, which compared very favourably with the best French fabrics, had a soft, full handle and light weight (5 ozs. per yard, 54 in. wide). This cloth was much admired. The Exhibition was visited by Representatives of the Board of Trade, Board of Education, Department of Overseas Trade, F.B.I., Drapers' Chamber of Trade, the National Federation of Launderers, London University, The Incorporated Association of Retail Distributors, and various London wholesale, retail, and shipping houses. Criticism on the whole was distinctly favourable and considerably more encouragement was offered by trade buyers than at the 1925 Exhibition. Below are a few examples of actual trade criticism—

In most cases these goods will appeal very much to the public.

You have got on to the softer touch, and away from the hardness and brittleness of a few years ago.

I like that clean slippery feel.

You have improved wonderfully in the touch and softness of artificial silk.

That is "Frenchy" in design.

What we want is effect; wearing quality has very little value, and more weight is no good.

I much prefer the botany cloths blended with artificial silk. The Botany cloths show no advance but here (artificial silk weft) and there is a novelty and it is definitely better for the market.

This is a distinct improvement on your last year's show.

One of your best cloths is that soft uncreasable spongecloth effect.

The construction of the cloths is excellent but the artistic side is weak.

This is the softest Bradford fabric I have ever handled.

It is lovely stuff but not a selling proposition in this country; there is nothing here I should feel like buying. From an educational point of view it is wonderful.

Bradford has done very much better lately; you are getting a softer handle. We have been hammering at you all the time about it.

Bradford has still got to learn a lot about handle; that goes a long way. The touch is everything.

People like all-wool cloths. If you say there is cotton in a cloth they won't have it. They don't understand what Botany really is, but the name goes a long way in selling.

Such Exhibitions without any prices being given would stimulate interest; the public are not educated to what is British.

The artificial silk introduced with wool gives the wool a much brighter appearance.

You would hardly credit these were Bradford goods.

I think you have nearly got the exact French thing; it is up to the tone, and the taste and the feel of to-day in women's dress.

The Bradford Textile Society is to be congratulated on inspiring the young men in the wool trade to produce such smart fabrics.

Professor E. Midgley, of Bradford Technical College, and Mr. Henry Binns, Hon. Secretary of Bradford Textile Society, were in attendance at the Exhibition and took note of the criticism offered.

VISIT TO HOSIERY MANUFACTURERS

On June 10th a party of members of the London Section of the Institute spent a very interesting and instructive afternoon in a visit to the works of Messrs. Dix, Watson & Co. Ltd., knitted goods manufacturers, of Alperton, Middlesex. After a hearty welcome by the Managing Director, the Works' Manager conducted the visitors on a tour through the factory. Opportunity was given to inspect each process from the winding of yarn to the finishing of the made-up garment. At the winding frames great interest was expressed at the variety of colours and of types of yarns employed. The jacquard machines, as used in connection with knitting, also attracted a good deal of attention and the visitors greatly admired the designs produced. They also noted with interest how many varied designs were produced by comparatively simple mechanism, some indeed so little complicated that the operator was able to memorise the design and subsequently adjust the machine during the knitting process so as to obtain the desired effect without further reference to his card. The visitors later passed through departments where seaming, buttonholing, teasing, calendering, and steam pressing were in progress and also viewed several specimens of made-up and finished garments. After the tour, the party was entertained to tea by the Directors of the firm, to whom a cordial expression of gratitude was tendered.

NOTES AND NOTICES

The Institute's Annual Conference

Postponed in consequence of the general strike, the Annual Conference of our Institute, originally fixed to take place at Buxton during Whit-week, is now being convened for the third week in October. It is hoped that the rearrangement of the fixture will not involve any material departure from the original programme. Sir William Bragg, K.B.E., has kindly accepted re-invitation to contribute the Annual Mather Lecture of the Institute and has engaged to attend at Buxton for

the purpose on the morning of Thursday the 21st October. On the Friday morning (22nd) it is expected that the papers by Mr. J. A. Robertson, M.I.E.E., M.I.Mech.E. (on Centralised Electricity Production), and by Mr. Percy Bean, F.C.S., M.Ph.S. (on the subject of Sizing), will be contributed in accordance with the programme previously presented. Printed programme and attendance form are in course of preparation for posting to members. Meantime, members are urged to make note of the dates of the fixture—at Buxton, Wednesday, 20th October, to Friday, 22nd October, inclusive. The proceedings will commence on the Wednesday evening with a reception. After the Conference on the Thursday morning, it is hoped to arrange for a visit to works at Macclesfield as originally planned.

Section Meetings of the Institute

Arising out of a recent meeting of the Lancashire Section Committee of the Institute, at which the possibility of availability of a paper of interest to the knitting industry was mentioned, it was agreed that endeavour be made to provide for such a paper to be presented at a meeting at Leicester—to be held under joint auspices of the Institute and the Leicester Textile Society. It is now proposed to hold the meeting at Leicester during the period of the Exhibition of Textile Machinery, and the date contemplated is the 16th October (Friday). Mr. Frank Nasmith has kindly promised to provide accommodation for the holding of the meeting and members of the Institute will be given opportunity to inspect the exhibition. Further particulars will be issued later. The paper at Leicester will be contributed by Mr. Herman S. Bell, of Nottingham, who will deal with the subject of "Thread Take-up in the Seaming of Knitted Fabrics." Mr. John T. Stokes, the Hon. Secretary of the Leicester Textile Society, has notified acceptance of the proposal to promote the meeting under joint auspices.

Textile Institute Diplomas: Fellowships and Associateships

Since the publication, in our July issue, of the list of additional names of members elected to the Fellowships or Associateships of the Institute, the following elections have been completed—

FELLOWS

BARBER-LOMAX, Joshua Arthur (Bolton).
CHADWICK, Arthur (Rochdale).
HUEBNER, Julius (Cheadle Hulme).
KERFOOT, James (Sidcup).
PADGETT, Charles (Bradford).

ASSOCIATES

BUTTERWORTH, Ernest (Stockport).
CRESSWELL, Albert (Blackburn).
DEARNALEY, Alfred (Hadfield).
GEE, Percy Herbert (Huddersfield).
HEYWOOD, William (Bombay).
JONES, George (Blackburn).
LEES, Robert (Audenshaw, near Manchester)
POMFRET, Harry (Rishton, near Blackburn).
ROTH, Alfred Bernard (Rochdale).
ROTHWELL, Herbert Theaker (Huddersfield).
SMITH, John (Walkden, near Manchester).
SPENCER, Arnold Kingsley Norman (Bradford).
WRIGHT, Robert Harcourt (Gatley, near Stockport).
WYKES, Alfred Launcelot (Leicester).

REVIEWS

Die Verwertung der Zellstoff-Ablaugen. By Dr. A. Schrohe; published by Otto Elsner Verlagsgesellschaft, Berlin (140 pp. and Index. 2 marks).

This book consists of abridgements of patent specifications filed since 1912, on the application of the waste liquors obtained during the manufacture of wood pulp. German, American, English, French, Austrian, Swedish, and Swiss patents are dealt with, the whole being classified in Section A, according to the particular uses for which the products are applied. These uses include the manufacture of alcohol, finishing materials, winding materials, fuels, manures, tanning materials, and others. In Section B the same patent specifications are arranged in the order of dates of application. The book is particularly useful to those inventors who are interested in securing patents on the subjects dealt with. —W.H.

Technologie der Textilveredelung. By Dr. P. Heermann; published by Julius Springer, Berlin (632 pp. and index; 33 marks).

This book is a very useful treatise on bleaching, dyeing, and finishing of textiles. In the introduction figures for the world production of textiles are given which would be more useful if brought up to date. The first section deals with the textile fibres. An outline of the research work done in cellulose up to 1925, including the X-ray work of Herzog and others is given. The physical and chemical properties of cotton, kapok, vegetable silk, linen, hemp, jute, and ramie are dealt with, together with statistics of production. Wool, animal hairs such as camel hair, wild and cultivated silks, and also mussel or sea-silk are dealt with in a similar manner. The various forms of artificial silk are considered and figures for world production up to 1924 are given. A chapter is devoted to the consideration of the properties of water, its purification by filtration and chemical treatment by the most modern methods, with description of apparatus used and also the treatment of sewage of effluents from textile works. The chemicals used in the textile industry are then considered : acids, alkalis, salts, bleaching agents, mordants, tannins, and moth-proofing agents, soaps, oils, and finishing agents, as well as thickening agents used in printing, and finally dyestuffs, including mineral colours, natural dyestuffs, and all the artificial dyes applied in modern times. An account of the practical methods of mercerising yarns and fabrics is given, but some of the machinery illustrated is very out-of-date. The production of transparent, opalescent, and wool (philanising) effects is mentioned. A full account of all the processes used in the bleaching of cotton is given and mention is made of damages caused during bleaching. The bleaching of linen, hemp, jute, and ramie finds mention. A chapter is devoted to the scouring, bleaching, washing, carbonising, and milling or felting of wool; a sketch being given in proof of the scale theory of felting which the reviewer regards as obsolete. The degumming and bleaching of silk is described, as well as the boiling and bleaching of mixed goods. A section of the book is devoted to dyeing and deals with the theory of colour, colour harmony, and colour mixing according to Ostwald's theory, of which an account is given with diagrams. The various methods of dyeing are then described, including basic, acid, and mordant colours on animal fibres; and direct, basic, sulphide, mordant, and vat colours, as well as diazo colours, on cotton and artificial silk. Various types of apparatus are illustrated for dyeing and drying. The methods of weighting silk are considered as well as the after-treatment of dyed and weighted silk. The dyeing of leather, fur, feathers, horn, straw, wool, flowers, grasses, and paper are dealt with. A section is devoted to the printing of fabrics of wool, cotton, and silk; another to the finishing of cotton, linen, wool, and silk, in fabrics and also in yarn; another also to the waterproofing and rubbing of fabrics and to the fireproofing of fabrics. This book is invaluable to those engaged in the industries to which it refers. —W.H.

GENERAL ITEMS AND REPORTS

"Dating of Patents" Committee

A Committee has been appointed by the Board of Trade to consider whether any, and, if so, what change is desirable in the practice of—

(*a*) Dating patents, applied for under Section 91 of the Patents Acts, as of the date of application in the foreign state; and

(*b*) Dating patents granted upon ordinary applications as of the date of application in the United Kingdom.

The main question which the Committee has to examine is whether this practice should be continued or whether patents granted upon applications made under Section 91 should bear some later date, such as the date of application in this country, or the date of grant of the patent, while still giving the applicant the priority as regards inventorship which must be given to him under international arrangements.

The Committee will be glad to receive suggestions or representations upon the matters covered by their terms of reference. In considering the questions involved, the Committee desires that due regard should be paid to all the interests involved, i.e., the interests of inventors, manufacturers, consumers, and the public generally. Communications should be addressed to the Secretary to the Committee, Mr. B. G. Crewe, The Patent Office, 25 Southampton Buildings, London, W.C.2.

British Association Meeting at Oxford ; 1926

The Hygroscopic Properties of Colloidal Fibres and their Relation to Technical Processes

Messrs. S. G. Barker, H. R. Hirst, and A. T. King, of the British Research Association for the Woollen and Worsted Industries, at a meeting of Section A of the British Association held on 10th August presented a paper under the above title in the course of which the theory of elasticity of colloidal fibres was developed, and it was shown that wool fibres possess the usual characteristics of colloids. Wool structure can apparently be represented by an elastic framework filled with a viscous medium. The effect of moisture absorption on the viscous phase was discussed, and it was stated that wool is a perfectly elastic material and makes a complete recovery from strain even up to its breaking point. The effect of moisture on thermal and electrical conductivity was discussed. In the former case it was shown that the increase in thermal conductivity of dry material for an increase of moisture content of 1% of the dry weight, ranges from 0·0000017 to 0·000002 for wool. The electrical conductivity is shown to increase with moisture content and it is noted that perfectly dry fibres are non-conducting.

Following an outline of the distinctive regain characteristics of wool as compared with other fibres, the relation between density and regain was discussed and an expression devised connecting apparent density with regain. Reference was made to the regain and swelling exhibited by wool with other liquids than water, especially with ethyl and methyl alcohols, and to the significance of this in arriving at the true density of wool by displacement methods, this value, 1·30, being obtained in benzene in which wool exhibits no regain or swelling. The variation of the true density and the apparent density in water, with regain was shown graphically A mathematical relation between the apparent specific volume, swelling and sorption (or liquid regain) in any liquid sorbed by wool was derived, which in the case of water, gave a calculated swelling in close agreement with the observed values. Reference was made incidentally to the analogous behaviour of gelatine.

The mechanism of the heat of wetting was discussed in relation to regain, swelling, and rate of evaporation, and the several theories of solid solution, liquid film compression, and surface area due to porosity were referred to. The evidence for porosity was discussed in detail and the conclusion was reached that the various phenomena are explained by assuming the keratin substance of wool to be of the type of structure observed in dried gelatin jellies, rather than to the surface area or due to any grosser heterogeneous structure such as would be involved in the individual cells of scales or cortex, or the easily observable pores found by Mark.

The swelling of wool fibres has been investigated by the authors, and the results of such swelling in air of various relative humidities and in water, alkalis,

acids, and organic liquids recorded. The accompanying physical changes due to sorption of moisture which may be described as variation in plasticity or pliability, were shown to be of great importance in technical processes of the wool industry. The significance of the hygroscopic characteristics of wool fibres with regard to manufacturing processes was also described.

Investigation of the fading of worsted cloths dyed with typical dyes of different chemical constitution, exposed to sunlight and air in India and at home, shows that there is a relation between loss of colour and the amount of moisture in the atmosphere. The sensitiveness of wool to bacterial damage has also been investigated, and shown to reach a maximum at the point of extreme saturation with moisture. In this connection reference is made to the damage caused by uneven trade conditioning.

The Colour Users' Association

Addressing the seventh annual meeting of the above Association on Tuesday, 27th July, Mr. H. Sutcliffe Smith, the Chairman, said that he thought the work done by the Association during the past year had proved extremely useful to all colour users and he thanked the Council, the staff, and all members for their share in the work accomplished. He then proceeded to review the work of the various standing Committees of the Association, and, referring to the Dyestuffs Advisory Licensing Committee, thanked the representatives of the Colour Users' Association for their services on this important Committee. Some idea of the magnitude of the work involved might, he thought, be gathered from a consideration of the figures of the Board of Trade covering licenses granted during the five years 1921 to 1925. In 1921 licenses covering an importation of nearly 3,000,000 lb. of dyestuffs valued at over one million sterling had been granted, while in 1925 the poundage had increased to 3¼ million pounds, though for obvious reasons the value had dropped. He suggested that the importation of approximately 1,500 tons of dyewares in 1925 compared with a pre-war importation of 18,390 tons, indicated considerable progress on the part of British makers, but suggested that there still remained a wide field of enterprise which should have the very close consideration and immediate attention of dyestuffs makers. "Unless British makers," said Mr. Smith, "make the fullest use of the remaining period of the Dyestuffs (Import Regulation) Act and are able to meet the complete demands of British users, particularly in the better types of vat colours and the specialities now offered by foreign makers, they will be in a serious position when the British market is eventually exposed to open competition." Turning to the work of the Joint Technical Committee of the C.U.A., Mr. Smith said that in his opinion there was one particular question in regard to which the services of this Committee would be of great assistance. He was convinced that something should be done to reduce the number of brands of dyestuffs now on the market. Hundreds of dyestuffs were produced yearly, of which only a few pounds had been sold. This was wasteful and uneconomical and if users would concentrate on fewer types for which they could give larger orders, makers would have a chance to produce economically and quote lower prices. Mr. Smith, considering the requisitioning of reparation colour from Germany by the United Kingdom, pointed out that no colour had come into the country under this head and that of the stock of colour on hand at the end of last year only about 450 tons remained to be disposed of. Reparation colour, he said, was still being imported by France, Italy, and Belgium, but as such colours were now being sold on a commercial basis no undue advantage was being given to the consumers in those countries. Continuing, the Chairman again drew attention to the great developments in the chemical industries achieved since his previous address. More particularly had these developments taken place in Germany and they were characterised by consolidation of interest, research on wide lines, and production in big units. He was satisfied, however, that there was evidence of continuous progress in the British dyemaking industry, but he wished to emphasise the vital importance of fundamental research and to point out that there was also a wide field for research into the improvement of technical methods. The Dyestuffs Industry Development Committee, the British Dyestuffs Corporation, Ltd., and the Interessen Gemeinschaft with its distributing company in this country were then dealt with by Mr. Smith, who concluded his address with comments on the observations of the deputation from the Association to France, Italy, Belgium, and Germany to consider dyestuff prices in those countries, and said that a complete report from the deputation would shortly be ready.

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PROCEEDINGS

LUNCHEON MEETING OF U.S.A. MEMBERS OF THE TEXTILE INSTITUTE

The following report of a meeting of U.S.A. Members of the Institute held at Boston, Mass., on the 5th August, is communicated by Mr. C. H. Clark, of Boston.

"The first meeting in this country to be held by members of The Textile Institute, England, took the form of an informal luncheon to Mr. W. E. Morton, Professor of Textiles at the College of Technology, Manchester, England, who has been here for several weeks on a visit to textile mills, and was held at the Exchange Club, 5th August, the following members and guests of the Institute being present. *Members*—Professor W. E. Morton, Manchester, England; Franklin W. Hobbs, Boston, Mass.; E. E. Blake, Biddeford, Me.; C. H. Clark, Boston, Mass.; F. J. Hoxie, Boston, Mass.; Edwin H. Marble, Worcester, Mass.; C. E. Mead, Boston, Mass.; Brackett Parsons, Boston, Mass. *Guests*—Russell T. Fisher, Secretary National Association of Cotton Manufacturers, Boston, Mass.; Clarence Hutton, *Textile World*, Boston, Mass.; Henry G. Lord, *Textile World*, Boston, Mass.; James McDowell, Somerville, Mass.

Mr. Franklin W. Hobbs, President of the National Association of Wool Manufacturers, and of the Arlington Mills, Lawrence, Mass., kindly consented to preside, and Mr. C. H. Clark, editor of *Textile World*, acted as secretary. Several of the local members regretted that other engagements prevented their being present, these including George L. Gilmore, of K. L. Gilmore & Co., Somerville, Mass.; E. D. Walen, Pacific Mills, Lawrence, Mass.; and F. W. Reynolds, Lockewood Greene & Co., Boston, Mass.

Professor Morton, in his talk, dwelt particularly upon the work of the Textile Institute, and in a somewhat less detailed manner on the work of the British Cotton Research Association with which he was formerly associated. He made it clear that in this country there was no exact counterpart of the Textile Institute both with reference to its membership and to its work, as the Textile Institute covered all branches of the industry and now was licensed under a Royal Charter to grant Fellowships and Associateships to members qualifying therefor. He also made it plain that the Textile Institute was not engaged directly or indirectly in research work, but that the source of most research articles published in the *Journal of the Textile Institute* was the various Government-aided British Textile Research Associations. He expressed the hope that the membership of the Institute in the U.S.A. might be so broadened as to make available to the parent body and for publication in the *Journal* of the Institute more reports and papers relating to textile research and practical and technical textile development.

There was a very general and lengthy discussion of the points raised by Professor Morton and with regard to the advisability of establishing a branch of The Textile Institute or some co-operating organisation in that country. It was the consensus of opinion that detailed discussion of this subject be deferred until a later general meeting of the U.S. members.

not all, of the four fixtures last-named, will be in association with local textile societies. The London Section, it is expected, will have announcements to make at an early date regarding its programme. Another meeting which may be here referred to is that which has been arranged to be held at Leicester at 4.30 p.m. on the 15th October. The fixture will provide opportunity for an inspection of the Textile Machinery Exhibition at Leicester as well as attendance, in the exhibition buildings, at a lecture to be given by Mr. Herman S. Bell (Nottingham) on "Thread Take-up in the Seaming of Knitted Fabrics." The Leicester Textile Society will take part in the meeting, and Mr. T. Fielding Johnson J.P. will preside. Members of the Institute in the Midland districts will receive notices of the meeting, but members generally who would like to attend and visit the Exhibition on the day in question should write the General Secretary of the Institute for ticket, and for voucher for securing return railway ticket at reduced fare.

Design and Structure of Fabrics

In connection with the Institute's Crompton Prize Scheme for students at Technical Colleges and Schools, the Committee has recently given serious consideration to various suggestions with regard to modifications of the scheme of competition. Mr. J. E. Dalton presented a statement to the Committee explaining the attitude towards, and criticism of, the scheme in various districts. One objection was that, at present, the scheme allowed students passing Section A of City and Guilds to compete in the same year. Further, it did not appear that the scheme of competition definitely encouraged the individual who approached design from the standpoint of the artist. The Committee decided to convene a conference of members of the Committee, and representatives of colleges and schools, and of various organisations associated with both employers and employed. The conference was held on the afternoon of Saturday, 11th September, when over 20 persons were in attendance. A prolonged discussion took place and the scheme was considered in the fullest detail, the meeting lasting for three hours. There was fairly general agreement that some effort should be made by the Committee to secure further limitation with regard to the number of specimens to be submitted by competitors. The Committee were also asked to define clearly whether the work of competitors was to be considered as a recognition of effort during an ordinary training course or work of a special, advanced, and original character. It was also agreed that the various groups of fabrics to be covered by competitors should be revised, and commercial terms employed for cloth description as far as possible. Perhaps the most important recommendation of the conference was that special consideration should be given to the question of division of competitors—Evening Students, Day Students, and Art Students—but the Chairman (Mr. John Crompton) pointed out that a division on lines suggested would require provision of additional prize money. It is expected that a meeting of the Committee will take place at an early date to give full consideration to the views ventilated at the conference.

Conference of Representatives of Textile Societies, &c.

A few years ago, this Institute sought to promote the increased usefulness of textile societies and kindred organisations by bringing together representatives of these bodies for discussion of matters of mutual interest. The result has been that, at least annually, the representatives meet at some suitable textile centre, and the Textile Institute has contributed to the movement by undertaking the secretarial duties. The next conference is fixed to take place at Blackburn Technical College on the afternoon of Saturday, the 9th October, by invitation of the Blackburn Textile Society and the National Federation of Textile Works Managers' Associations. The programme announces a reception at 3.15 by Mr. Chas. Tate, President of the Blackburn Textile Society, and Mr. J. H. Dawson, President of the Federation already named; inspection of an exhibition of designs

and cloths produced in the college; and inspection of the Textile Department and the Textile Chemistry Depratment of the College. Tea will be provided in the College by the organisations concerned in the invitation to visit Blackburn, and afterwards there will be a discussion on "The Work of Textile Societies and its Relation to Technical Education generally."

Publications added to the Institute Library

July to September 1926

Books

Transactions of the Manchester Association of Engineers. 10 volumes, from 1906 to 1914. Presented by the Hon. Treasurer, T. Fletcher Robinson Esq.
Hosiery Yarns and Fabrics. J. Chamberlain. Official Text Book, Leicester College of Technology.
Handbook of Weaving and Manufacturing. H. Greenwood (Pitman & Sons Ltd.).
Testing of Yarns and Fabrics. H. P. Curtis (Pitman & Sons).
Wärmewirtchaft in der Textilindustrie. F. Möller (Verlag T. Steinkopff).

Pamphlets

British

Association of Special Libraries and Information Bureaux. Report of Proceedings of Second Conference.
Industrial Fatigue Research Board. "Fan Ventilation in a Humid Weaving Shed."
Department of Scientific and Industrial Research—
"The Movement of Moisture with Reference to Timber Seasoning."
"Illumination Research."
Empire Cotton Growing Corporation—
Report on the Cotton Growing Industry of Nigeria.
Report of the 5th Annual General Meeting.
Report of the Administrative Council.
British Cotton Growing Association—
Report of the 21st Annual Meeting.
"India and the Sudan Re-visited."
"Kenya, Uganda, and Tanganyika."
The Constants of Flax Wax. W. Honneyman.
Liverpool Cotton Annual 1926.
Royal Society of Arts. Report on the Competition of Industrial Designs 1926.
Industrial Welfare Society. Superannuation Schemes.
Technical College, Bradford Calendar 1926-1927.
College of Technology, Manchester. Prospectus of Courses 1926-1927.
City and Guilds of London Institute. Programme for Session 1926-1927.

Colonial

Union of South Africa—
Science Bulletins Nos. 47, 48, and 49.
Reprint No. 4, 1925.
Trade of the Union for January and February 1926.
Indian Central Cotton Committee—
Results of Spinning Tests on Standard Indian Cottons.
Comparative Spinning Tests on Machine-ginned and Saw-ginned Cotton.
Bengal; Department of Agriculture. Annual Report 1924-1925.
Bombay Presidency; Department of Agriculture. Annual Report 1924-1925.
Bengal, Bihar and Orissa, and Assam. Preliminary Forecast of Jute Crop 1926.
Jamaica; Department of Agriculture, Annual Report 1925.
Kenya; Department of Agriculture, Annual Report 1925.

Foreign

U.S.A. Bureau of Standards—
Scientific Papers, Nos. 513, 514, 520, 521, and 523 to 526.
Technologic Papers 297, 313, and 315.
Miscellaneous Publications No. 70.
U.S. Department of Commerce—
Elimination of Waste Series. Nos. 28, 31a, 40, 45, 47, and 49.
Crop Production in the United States 1925.
University of California. Publications in Entomology, Agricultural Sciences, and Botany.
Ministry of Agriculture, Egypt—
Technical and Scientific Bulletin No. 61.
Fourth Annual Report, Cotton Research Board.

REVIEWS

Textile Bleaching, Dyeing, Printing, and Finishing Machinery. By A. J. Hall; published by Ernest Benn, Ltd., London (317 pages and index; 50s. net).
This book, as its name implies, deals with the description of the machinery used for bleaching, dyeing, printing, and finishing of yarns and fabrics of cotton, wool, and silk and is profusely illustrated, there being upwards of 300 illustrations mainly from machine-maker's catalogues. A buyers' guide is given at the end. The book should fulfil many requirements; it will, for instance, save textile students a lot of time in sketching in their note books the machinery used in the industry and will serve to show those already familiar with the industry other types of machines than those they are familiar with. The work is mainly descriptive and does not assist a newcomer in deciding which of the various types of machine described is most efficient for their particular purpose. In view of the fact that the book also contains advertisements by the various firms whose machines are illustrated, the author ought perhaps to be complimented on avoiding favouritism. The book would have gained value by the inclusion of several modern machines, for example, the cylinder drying machine of Dod Bros., Manchester; the continuous hank drying machines of A. N. Marr, of Leeds; several other forms of hank mercerising machines used in the manufacture of book cloth, leather cloth, and rubbered fabrics; and Brandwood's bleaching and dyeing machinery. In fact, a book of this kind needs to be very much up-to-date to be of real advantage to those familiar with the industry. The printing, binding, and general get-up of the book is well in keeping with the standard set by its publishers and should find a ready demand. —W.H.

Wärmewirtschaft in der Textilindustrie. By Fedor Möller. Published by Theodor Steinkopff. Dresden & Leipzig, 1926 (108 pp. and Index).
This little monograph dealing with fuel economy in the textile industry should be very opportune at the present time. It gives a clear account of the various causes of loss of heat in spinning, weaving, dyeing, printing, bleaching, and finishing, and discusses the various remedies. The course of heat supply is followed from the boiler house onwards and each room or section is dealt with in considerable detail. At each stage the amount of heat utilised and the amount lost is worked-out numerically, often a balance sheet drawn up, and the pros and cons of alternate methods of using the heat discussed. From the figures given it would be easy, by making the necessary changes, to calculate the efficiency of any textile factory as far as fuel is concerned. The author lays stress on the necessity for rigid control if efficiency is to be maintained. The numerous diagrams help one to visualise the extent to which heat is lost in the various processes; unfortunately they lose value by being reproduced on too small a scale. The book ends with an extensive bibliography of the literature, which will be helpful to anyone wishing to pursue the subject further. —R.G.

Liverpool Cotton Annual, 1926. Compiled by Charles Rigby. Published by Robinson and Rigby, Liverpool (56 pages, 2s. net.).
This is an attractively produced newcomer among annual publications, and is an attempt, according to the "Editor's Note" to provide a reference book that will demonstrate "Liverpool's pre-eminence as a cotton market," and "convey an illuminating vision of the intense human energies which enter into the daily life of the cotton exchange." From the point of view of an annual publication on its first appearance it is perhaps rather harsh to suggest that probably none of the contents of this annual, with the exception of the statistics, will require repetition. At the same time it must be admitted that the articles included, from the historical notes with which the annual opens to the abstract of a lecture on research in the cotton industry, are all interesting and well worthy of record in connection with Liverpool and its cotton trade. A similar series of articles in subsequent "Annuals" dealing with other phases of the cotton activities of Merseyside would certainly furnish something new in Year Books, and the series would eventually acquire definite historical value. If this is the compiler's idea it seems to be a good one. A word of commendation must be passed for the printer's share in the work, but more care should have been taken in proof reading as several typographical errors have been missed. The annual is well worth the price asked. —H.L.R.

Air Conditioning in Textile Mills. Edited by Albert W. Thompson. Published by the Parks-Cramer Company, Boston (495 pp., price $5.00).

This is a work compiled under the auspices of an American company who specialise in air conditioning in textile and other factories. One does not expect, of course, in such a book the critical impartiality of an ordinary text book, but the present work does not display any displeasing crudity of advertisement, and gives the general impression that it is a carefully compiled and sound semi-popular treatise on the subject of humidity in relation to textile manufacturing.

The book may be divided into the following main divisions: Chapters I. and II., dealing with the effect of humidity on the properties of the various textile fibres; Chapters III., IV., V., and VI. dealing with the most favourable conditions for processing; Chapter VII., dealing with regain testing and standards, tensile testing, and regain equilibrium between textile materials and the atmosphere; Chapters VIII., IX., and X. with humidifying installations and the underlying scientific principles, and Chapters XII. and XIII. respectively with the effect of humidification on health, and the effect of external weather conditions on the factory atmosphere.

The book covers a wide range, every aspect of the subject being discussed, and it may be admitted at once that it is a distinct achievement to recognise every aspect of such a far-branching subject, so that the compilers are to be congratulated on the mere table of contents. When one comes to examine the work in detail, it is evident that it is very unequal. The more propagandist portions are extremely well written and avoid the error of exaggeration. The sections dealing with textile technique are good, especially when one considers the difficulty of collecting reliable information. The scientific side of atmospheric humidity is admirably treated, being clear, accurate, and displaying considerable critical ability (though the writer is rather too severe on the ordinary wet and dry bulb hygrometer, which in its proper sphere is a very useful instrument). The weakest section is Chapter VII. dealing with regain from a scientific point of view. No reference is made in it to the work done under the auspices of the British textile research associations, though much of it is in direct opposition to views held previously. The general level of this portion of the book is perhaps best illustrated by the extraordinary remark on p. 213: "The general laws relating to regain in textiles as deduced from the research of Hartshorne and his predecessors are now generally accepted. . . ." The part of Chapter VII. dealing with tensile testing is more satisfactory, though the various data are imperfectly correlated with each other and with the chapter on the effect of humidity on the single fibres.

Chapters III., IV., V., and VI. are evidently founded on American practice, which appears on the whole to agree with English practice when allowance is made for climatic differences. Two recommendations given in Chapter IV., however, appear strange. Humidifying a combing shed to 70% relative humidity is surely unnecessary, not to say undesirable. On the other hand, 65 to 75% is undoubtedly low for French drawing. —S.A.S.

GENERAL ITEMS AND REPORTS

Royal Society of Arts; Competition of Industrial Design, 1926

The report of the third year of this annual competition has been received, and it is noteworthy that on the whole the judges consider that the standard of excellence is very decidedly higher than on the two former occasions. The Council records that they have received assurances from many quarters that the competition has aroused the greatest interest amongst students generally, and that in some schools work is being carried on with a zeal and earnestness not known before. That the interest in this scheme is wide-spread may be judged from the list of Schools of Art from which competitors were entered. Schools as far apart as Belfast and Bournemouth or Kirkcaldy and Ipswich provided entrants, while the name of the Technical College, Wellington, New Zealand, is also included. Apart from the interest of the students and schools of art, evidence is offered in the report that the various industries concerned also look upon the scheme with favour, and a large number of firms have offered

special prizes for particular subjects. Altogether, more than £1,700 has been distributed in prizes during the last three years. An exhibition of specimens selected from among those entered for the competition was held in the Upper East Gallery in the Imperial Institute from 31st July to 31st August, and served a very useful purpose in bringing the work of the Royal Society of Arts in this particular direction before the public. Of particular interest is the section of the competition devoted to textiles, which is controlled by a strong and representative committee under the chairmanship of Sir Frank Warner K.B.E. Entries in this section may be made under one of six alternative sub-sections, which are as follows—(1) Floor coverings; (2) Woven fabrics for furniture and decoration; (3) Printed fabrics for furniture and decoration; (4) Printed and woven fabrics for dress goods, handkerchiefs, ties, mufflers &c.; (5) Machine-made lace and embroidery; and (6) Miscellaneous, including hand-made lace, cushion squares, batiks &c. The judges' reports on these sub-sections should be of value to those whose business it is to advise and train student-entrants for future competitions. For example, it is recorded that many of the designs submitted in sub-section (1) were on dull and stereotyped lines, and that it is regrettable that there should not be more evidence of a freshness of thought. Sub-section (2) judges report that while the level of merit is decidedly higher, some of the designs were coloured in such a manner as to indicate that the students had not visualised their designs in fabric form. The judges in this sub-section also record that in their opinion the attention of both designers and manufacturers should be called to the fact that though the present fashion is in favour of small mats for dining-room tables instead of large cloths, no designs were submitted of the former. The report on the design submitted in the dress-goods section states that it is a mistake to pay any attention to a "fashion" of a previous day, the only "fashion" worth considering being the current one. The judges also report that it was gratifying to see more economy in the use of colour than usual; charming effects being obtained in some cases by the use of only three colours. Over-elaboration is pointed out to be a mistake, and in this connection it is suggested that motifs might be more carefully considered; many designs contained enough motifs to make half-a-dozen good designs. Students should note that designs in this section should be executed in flat colour, as for printing the engraver must be able to understand clearly what is meant. In this sub-section one of the Society's Travelling Scholarships was awarded to Miss Pauline Athey, a student at the Manchester School of Art. In sub-section 5 (Machine-made lace) the report states that the designs submitted show, on the whole, an appreciation of the situation and needs of the lace industry at the present time, and records that in many cases this has been done without setting aside past tradition. As a guide to students it is pointed out that as far as possible design should show the effect of the texture itself. For instance, where the lace is intended to be white or lighter in tone than its background, an ink or pencil line on white paper does not produce the desired effect. It is interesting also to be able to record that for the benefit of those competitors whose work is approved by the judges for exhibition, a bureau of information is to be started where their names will be enrolled if they desire to obtain employment as designers. The information will be at the disposal of manufacturers, and it is hoped that both manufacturers and designers will find the bureau of service.

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PROCEEDINGS

THE COTTON TEXTILE INDUSTRY IN THE U.S.A.

The first luncheon-hour meeting of the 1926-1927 session of the Lancashire Section of the Institute was held in the Council Room, Manchester, on Friday, 24th September, when Professor W. E. Morton and Mr. H. G. Greg delivered addresses upon the information and experiences they had gained during a recent visit to the U.S.A. Mr. Frank Nasmith presided, and there was a large attendance of members.

The Chairman, in introducing the speakers to the meeting, said that the Lancashire Section was endeavouring to arrange for the giving of a number of lectures dealing with methods of textile manufacture in various foreign countries. It was also hoped there would be a lecture, before the Christmas period, by a gentleman from Kettering upon the subject of "Price Forecasting," while prior to March next there would be one by the Chadwick Trust upon "Industrial Fatigue," and a third by Sir William Himbury entitled "Raw Cotton Supply." The Lancashire Section had tried to map out a very strong programme for the year, and, from the excellent attendance upon the present occasion, it certainly appeared as though they would have a thoroughly good session. The second lecture of the session would be delivered by Capt. Sherston, and was entitled "Impressions of a Recent Visit to Italy."

Professor W. E. Morton said—In planning out our effort for to-day Mr. Greg and I decided that the best thing would be to divide the proceedings into two sections, in the first of which I should deal with the technical details of interest and that he would follow on with points of more general industrial organisation. Obviously, in five weeks' touring one can pick up quite a considerable number of extremely interesting facts, but it is only the more important of these that I shall now be able to touch upon.

Commencing with the first operations of the spinning mills, the most notable feature was the difference in opening machinery compared with what we have in this country; not in the actual machines themselves but in the quantity. The Americans have nothing like the huge combinations of opening machinery one normally sees in spinning mills in this country. They are not very fond of up-stroke beaters. They have down-stroke beaters and a scutcher and laphead, and then only one finishing scutcher. Their mixing is done by the stack method for what they consider to be medium counts and for what we consider to be fairly low counts, 36's and 40's. They have their mixing bins in separate buildings from the blowing room, and the material is conveyed by pneumatic trunks. By that means, they avoid having to pay rather high insurance premiums. The reason for the small equipment in opening may possibly be found in the type of cotton used. We expected when we went there to find the same kind of cotton one uses in this country. We asked "What is this cotton ? " They said "That is Arkansas, Texas or Memphis cotton." In some cases we saw local cotton. But it never seemed to be the same as the "Arkansas," "Texas," or "Memphis" cotton that we use in this country. The difference is possibly rather hard to describe, but it has a rather harsher, harder, and more wiry "feel," and I should imagine it would be a much more easily cleaned cotton, which may account for

the reduction possible in opening and cleaning apparatus. The "Crighton" opener was not much in favour, but we understand it is rather coming to the front. Also, we saw horizontal cleaners something like those used in the early days of cleaning machine development. Apparently, they were rather afraid to have splitting laps in the carding, because we saw in every case the cards were fitted with a device for avoiding this, which apparently overcame their difficulties. The only other point of interest in the opening and blowing was the supply of air to the fans for the scutchers Normally, they have to put a great deal of humidity into their atmosphere, and it costs them a good deal to do it, so they cannot afford in the more up-to-date mills to have this expensive humidified air drawn through the fans and out into the dust towers. In the case of two mills we found they have special ducts for drawing dust up from the scutchers and out through the fans again. In that way, they avoided withdrawing air from a mill which had been expensively humidified.

Generally speaking, the carding was good, light, and relatively slow, but the stripping devices were the "Saco-Lowell" type of stripping, which, by turning a handle, can be turned over either to the cylinder or the doffer. There is no dust thrown out into the room from the stripping processes; it is all drawn away by suction. On the whole, we do not consider it is a very effective method of stripping, though it has an advantage over the "Cook" system in that the waste is better for selling to the waste dealer. In regard to the draw frames, one very rarely observed more than two heads to the draw frames. They seem to run on the system there of cutting down the processes as much as possible, consistent with obtaining good work. I know many people think it will ruin work to cut out either a speed frame or a drawing frame, but for their purposes there must be something in it because they are eminently careful in investigating problems, in which respect they are very much more systematic than, I think, we are in this country. One point was raised by a mill engineer, I think in Greenville. He advocated the use of five ends up for drawings instead of six in order to get a better selvage. I do not know how it would apply in this country, but apparently it would have a use under their conditions. Combing we found extensively used for what we call medium counts, even as low as 30's, especially if used as hosiery yarns, although in one mill they admitted it was probably not as effective as a good carded yarn.

They have very little mule spinning as compared with ring spinning, and, on inquiry, we found that the reasons are two-fold. First, there is the difficulty in getting really skilled spinners, and, secondly, those that they had had strong unions and were causing them trouble. They will apparently sooner put up with spinning reasonably high counts on ring frames than have bother with the unions. The next thing, as I think most people know, is the saddle weighting for all top rollers of the spinning frames. Only in one mill that we saw had they middle top rollers. They are very chary of high drafts, and this particular mill were anxious to go as far as they possibly could with the existing roller arrangement. They were in the middle of their investigation, and I do not know how it worked out. Ordinarily the drafts we saw were fairly high—six to ten.

The frames are nearly always band-driven which they find pays them as they get surer work. They admit it takes rather more power but it has the advantage of surer working in starting in the early morning. We found that the warp yarns were nearly always weft built; that is to say, they had not a straight build on their bobbins. They said this gave easier readying, and there is less likelihood of the unskilled operative pulling the bobbin to pieces, while they get more on the package. I cannot believe that, because if you have the threads crossing over, as one has to have in a weft build, it is inevitable that the package must be softer. They say they get less breakages. They were using large bobbins, up to 8 or 9 inches, bigger than we have in this country at any rate. Before leaving the spinning frames one cannot help mentoning the "Saco-Lowell" spinning frame. We saw one of these. The gearing is at the opposite end to the drive.

The main shaft runs through the tin roller, and the gearing is covered in by doors which can easily be opened; not heavy cast-iron plates which have to be lifted out without much room to do so. The gears are all helical cut, and they consider they get steadier and more regular running with them.

Turning to the sizing, we observed that a very light size is generally used; in no case did we find more than 10% and it is usually about 5% to 7%. Where they were winding on for a multi-coloured warp they wound on through a reed to facilitate drawing in. In their sizing rooms the lack of steam and water was very noticeable. Usually they had huge copper hoods for drawing-off the steam, and carefully designed ducts in the floors for water. On the whole, the rooms were much cleaner than I have seen them elsewhere.

The dyeing is rather interesting. We observed in one mill the complete spinning of dyed stock; that is to say, the material is brought in in the bale, opened, and cleaned with a small amount of opening machinery, and then dyed straight away in a huge cylinder. It is then dried, and spun in the dyed form in their various stock colours. By that means, they are able to get a very level colour, and, as far as weft is concerned, they can cut out one of the preparation processes in winding. We asked if they used oil for making the stuff work rather better but they said "No." Apparently they had tried it and found it did not do any better than mere water. They have a system of spray humidifiers spraying water on to the cotton in the hopper feeder. The next thing about dyeing is the use of "Franklin" dyed yarn for weft. They wind the yarn on to packages, and have it dyed in that form, and then pirn it and use it directly on the weft. The levelling of the dyeing is not good, and it will not do for large quantities of colour, but for pin stripes and narrow stripes the mill people find it quite satisfactory and rather cheaper. In wefts we found a prevalence of chain dyeing followed by pirning on quilling frames, that is, multiple-spindle winding frames.

In the weaving room, except for drop-box looms, dobbies, and jacquards all looms were automatics. We saw two-colour automatics for weaving ordinary two-coloured ginghams, and even in the exceptions to the automatics we never saw an over-pick loom. They were all under-pick, warp-stop motions, even on the non-automatic looms. For what they consider low counts, and below them, they have steel heddles as a rule, and for finer counts the ordinary cotton heald predominated. Another interesting thing in connection with looms appears to be a movement in the South towards the use of a deeper reed, deeper dents, so that they are stronger and less liable to be bent, and, of course, thus form cracks in the cloth. Finishing and making-up are all done in the same mill. Perhaps I should have mentioned before that in every case we saw the whole of the processes from raw cotton to the finished fabric ready for sale carried out either by one mill or by a group of mills working in conjunction.

I will now turn to more general things and deal with the lay-out. First of all, there is the large amount of space available for temporary storage and for rapid internal transport. The importance of this was stressed many times by the managers, and it was evident in every department, and, in particular, the slasher and sizing rooms where they have big gangways and plenty of room for moving things round. They have, in the up-to-date mills, automatic conveyers, and make as much use as possible of gravity feed; that is to say, they start the raw material on the top floor and work downwards. The material is put into suitable boxes, it is carried along to the end of the room along rollers, and then shoots down a spiral shoot on to the next floor ready for the next process. For moving warps to the sizing room, I think I am correct in saying in every case they had overhead mono-rails for taking the materials away, and not trucks on the floor.

The next point is the lay-out of the machines in the rooms. Generally speaking, instead of having the rows of machinery down the length of the room, as we usually find in this country, they have them the other way, across, with shorter and rather less diameter shafts than we have; that is to say, when they use

overhead shafting at all. I should say in most cases the machines are individually driven, even the opening machinery and cards, and so on. Then they take very great care in the planning of their lighting systems. In nearly all cases they have the R.L.M. reflector. You can go into the rooms at night without experiencing any uncomfortable sensation due to glare. In one or two machine works or shops we observed the use of mercury-arc lamps. They gave a very good light, two or three feet long, and you can look at them without getting blinded, relatively speaking. Labour-saving devices are adopted practically everywhere. They endeavour to cut out human effort in all details. They avoid having a man whose job it is to do nothing else but push things about on the floor.

In one mill we saw a "Barber-Colman" bobbin winder and high-speed warper. The bobbin winder does all the piecing up. All the operative has to do is to bring along the spare bobbins and put them in the frame and the machine "does the rest" at a remarkably high speed. The high-speed warper runs at a speed of 500 yards per minute or little short of 20 miles an hour and makes an extraordinary good warp, a 31,000 yards of 29's complete, and, allowing for short stoppages, run in 80 minutes. Then we found there is a general use of weavers' knotters in order to save time. There is no hand knotting. There is no kissing of the shuttles. All shuttles have self-threading eyes, and cast-iron eyes are favoured more than the brass ones. There is an extensive use of compressed air for cleaning opening machinery, with nozzle-pressure of 40-60 lb. per square inch. Admittedly, they make a lot of dust in doing it but it does not settle back on the machines. They will go round with the compressed air nozzle for so long, and then sweep away the stuff on the floor. In that connection, there is a very interesting cleaning device used for ring frames; i.e., a blower—a small electric fan—travelling on a mono-rail over all the frames in one room. It consists of two arms down which air is propelled on either side of the frame. It simply moves along the frame blowing dust down. You might say that that stirs up a current of air and makes the dust fly, but it has the advantage that it does not allow the dust to collect, and you are not likely to have slubs and that kind of thing in the spinning, while the dust always collects on the floors.

I would like to mention one or two points concerning technical education. It is evident that America relies almost entirely on its technical development for keeping its place in competition, not only as between the North and South States, but with other countries. Consequently you find the mill men in America have a very much greater interest in the work of their technical schools. The specialisation of the operatives' job makes it such that they cannot draw on that class of people for their overlookers because they do not get sufficiently extended experience, consequenty they rely on the technical schools to turn out overlookers. They admittedly have to go through some sort of experience. They do not come straight from the school to take on the job. The mill superintendents and the executive class rise of course from the overlooker class. Also, the people who are determined to go straight into executive positions attend the technical schools very regularly. Technical education in textile matters is supported wholeheartedly. The Massachusetts Institute of Technology wanted to raise five million dollars for extensions to buildings, and they had four million dollars subscribed provided that they could raise another million dollars in six months. They did it in three months, and they got the five million dollars.

Another point might be worth mentioning; that is the overlookers there apparently take much greater care in the training of new operatives than one finds to be the case in this country; consequently the operations are carried out uniformly throughout the mill and not left entirely to the ingenuity of the operative himself.

Finally, the interchange of ideas is very free, and much freedom in allowing other men to come round their mills is permitted. That applies particularly in the South. Their attitude is this—You can get just as much out of the other man if he goes round your mill as he gets out of you, and it always helps you to

discuss your problems with him, and you learn more by going round seeing other people's mills than you do in any other way. At the end of the trip a man asked me if we had had any difficulty in getting round the mills. I assured him that we had not and that we were shown everything, and that in many cases we were told things which were distinctly in confidence but they trusted us. He said, "Mr. Morton, when you get back to your country you might tell your people that; because I tried to get round a lot of mills in your country and I did not succeed in a single case."

Mr. H. G. Greg said—I should like to sketch the methods of production in America, as far as the personnel and their domestic difficulties are concerned. It is perhaps particularly interesting to look at this problem to-day because in America there are two distinct sources of production. You have the Northern mills, the New England Mills round Boston, some of which have been in existence for upwards of 50 years, and the Southern mills which extend practically throughout the cotton-growing belt in Texas, Oklahoma, Georgia, and North and South Carolina. The Southern mills have certain advantages as far as labour is concerned. In most cases their hours of employment are not controlled by any State Laws, whereas in the North they have their own laws, which would roughly correspond to city and urban district council bye-laws in this country, as opposed to Federal Laws, or what we term "laws of the land." There are no Federal laws covering hours of labour in America in the textile industry. The North is now beginning to feel competition from the South where the conditions are rather easier as far as labour is concerned. They have been faced with the problem we are facing at present of the tailing-off of markets and of difficulty in securing business. In one or two cases we heard it mentioned that during the war the capacity of the country to produce textiles had increased out of all proportion to necessity; the capacity of the country to absorb the goods being now much reduced. These people are really out to get business, and they have said "The business is there if we can get it. If our competitors can get it we can get it, and it is up to the best man to get the business, and we are going to be the best men." I will take one particular instance of a mill which they told us would have closed down in a couple of months if it was run on the lines it was two or three years ago. They were literally desperate. Their method of tackling the situation was to get scientists to study their scheme of production. The scientists realised to begin with that the essential thing was to get the work to run well. They realised that there are certain operations such as creeling, doffing, and warp-changing that are discontinuous since each involves periodic replenishment of bobbins, beams, &c. They realised also that if they could stop end breakages their whole scheme would go through more smoothly. The first point they dealt with was the humidity. They proved conclusively, as it had been proved in this country, of course, that cotton spins best under certain conditions of moisture and certain conditions of moisture are more pleasant to work under. In their climate they cannot guarantee humidity at all, and they go in very extensively for humidification and pay great attention to it. In most cases it is done on systems like the "carrier" system, whereby they have all the windows shielded. They keep the workrooms under slightly greater pressure than atmospheric pressure, and they push "doctored" air in; "doctored" to the right temperature and humidity. The air works out through the windows and doors and liftways, and so on. Roughly, I think their figures are about 62% relative humidity for spinning and 82% relative humidity for weaving.

The next point they considered was how best to apportion their labour. I would like to take a spinning frame as an example, because from that we may get their idea which we can then apply to cards and other machinery. The most important thing is the actual piecing up of an end; the most difficult operation to perform. They, therefore, took the number of frames they had, after they had satisfied themselves the work was running well. They discovered how many breakages there were per day, and how long it took a particular individual to

piece up a particular end. They found out how many ends per diem an individual could piece up. They then worked out how many frames would give that individual just that number of ends to piece up. They realised it was a waste of time having that individual dusting, seeing to broken bands and tapes, and creeling, and that it was a less-skilled job which could be done by someone who was paid less wages. They found that all the subsidiary operations like creeling, oiling, and banding could be mapped out. Therefore, we get the extraordinary position of one spinner minding up to 24 ring frames, but we must realise that he or she only pieces up ends and does not do the whole operation.

Another way in which they have been able to economise is by grouping their mills together in big federations with a central clearing house for the receipt of orders, so that the various orders can go to the mills most fitted for their production. This enables individual mills to keep to very few counts of yarn and to plan out their production between their opening, cards, drawing frames, combs, down to ring frames and looms, so there was no bunching of roving in one place and no lack of intermediate bobbins in another place. In one intermediate frame the bobbins in a creel were dressed like a regiment of soldiers. At one end the bobbins were full, half way down part full, and at the other end empty. The creelers knew exactly at any minute of the day which particular frame they should be creeling and which particular frame would be next to creel. They were there with their barrels, and took the empty ones out and put full ones in. All frames had special doffers for the job—intermediate, jack frames, and spinning frames. All the organisation, of course, is based fundamentally on piece rates of wages. The spinner was paid on the production of the 25 frames minded, the doffers were based on the 20 or 30 frames they doffed, and creelers were on exactly the same basis. In every case where piece rates have been established the work has been split up so that the operative can produce more than before piece rates were established, and the operative has been given a very material benefit upon increased production. For instance, by the splitting up of labour one spinner, instead of minding two or three frames, doing creeling, piecing and everything, would turn out very much greater weight of yarn on 24 frames. She did not get the full advantage of the production of 24 frames as if she had creeled and cleaned them but she did get a very material advantage. This brings about a very curious point of view. When they start piece rates, first of all, they have to establish a basis of average earnings for a spinner. They then base the piece rate so that the spinners may get 10% or 20% more wages than on a day rate if they do a stated and reasonable amount of work. Whereas the day rate was 60s. a week, they are now earning 80s. a week. Any further piece rates will probably have to be based on the 80s. and they will probably get 120s. What will happen after two or three generations of that sort of thing having occurred I do not know, but that is one of their problems.

The present situation in America is interesting in most cases where automatic looms have been started, and where this entirely new method of splitting up work is concerned. There have been strikes, the workpeople saying that the mill owners are trying to get the better of them, and that the conditions meant starvation for them. A strike usually lasts from one month up to nine or ten months. In America if they have a strike they let it go on. They believe that after a time the strike will be over and the workpeople will come back on the owners' terms. But the mill managements are now going in more and more for the policy of educating their workpeople and of taking them into their confidence. They are finding it a tremendous advantage to do so. The managements are only too glad to have a quiet talk over the table in the evening with their workpeople while they all smoke their pipes. They explain their difficulties, how their production is too costly, and point out the mutual benefit of adopting a new system. The workpeople, nowadays, instead of being suspicious, appreciate the point of view of the management. They appreciate that the management are not altering the scheme of things purely for their own benefit, but that there

is a very material benefit also to the workpeople. They are giving the management their wholehearted support in consequence.

In the Northern States the workpeople are of many races, comprising practically every nationality. You can go into some mills and see notices posted up in from four to ten different languages. There is not the same solidarity of labour by any manner of means that there is in this country. If one mill goes on strike the mill next to it has not the least compunction in taking in their workpeople or doing all their trade. They look upon the situation in this way—"Well, these people are more stupid than we believe ourselves to be. We treat our workpeople well. They will stand by us. If they are unlucky, and cannot go on without a strike, and it is any benefit to us, we shall take the benefit."

Another point about the labour situation is the extraordinary fluidity of labour. If a man has been a cabinet maker, and he finds that from some cause or other cabinet making work is not available, he will turn his hand to something else. He may go for a short time to a technical school during the daytime, and he will keep himself by taking a night watchman's job or working an elevator during the night, which seems to be the stock job for anyone who gets the "sack." Then he goes to a mill. He will go through the hands of the overlooker, who will go to great pains to teach him the proper way to do things. If they can make him do things they will keep him; if they cannot then they have not the least compunction in dismissing him. Their method of determining a man to be what he claims to be is to see him at it. If there is a blockage through one operative being slow, they will go to considerable pains to investigate the case and to see if the work is right, if the frames are most convenient for the height of the worker, or if the light is wrong. Then if they are satisfied that they cannot increase the production of the operative through mechanical means they resort to dismissal. Owing to the relative scarcity of labour anyone who is "sacked" from one job can get another job without difficulty if they have really the will to work.

Another point to which they pay great attention is advertising. They like to produce what is most suitable to them, and they plan out their mills to produce it easily and very cheaply. They go to great pains in advertising their products in order to get buyers to say "The stuff you are making is just what I have been looking for."

It has already been mentioned that a mill likes to do all its blowing, spinning, dyeing, weaving, bleaching, and finishing under one roof. That enables the management to secure a balanced working and to retain the profits from the intermediate processes. It enables the spinner to appreciate the weavers' difficulties with their yarns, and the spinner is able to rectify any faults and make the weavers' work easier. The finisher gives advice to the spinner. The whole thing is very much quicker in its cycle. If you have the whole thing under one roof you can push the spinning and weaving through quickly and get on to the finishing, whereas if it is split up the finisher may have a lot of work in from somewhere else and there is a stoppage. They have recently adopted a system of "selling houses" by means of which they are enabled to get in direct touch with the customer, and thus enable the manufacturer practically to have his own finger on the market's pulse. That is almost as big a development as any that they are going in for.

The conditions in the South both in respect of results or methods of production differ greatly from those in the New England mills. There are no mill towns in the South. There are no "Stockports" or "Boltons" there. When people build a mill they also build a town for their operatives. Not only do they build the houses that the operatives live in but they build a school, a church, and very likely a technical college; there is nothing in the village except the mill and the operatives. The mill runs its own baseball team, its own cinema, and they rent their houses approximately at a rate of one shilling per week per room. Therefore, they have a pretty good control over their workpeople. The workpeople cannot move into another town or into another house because it is all

controlled by the management and there they have to stay. The management are complete despots but they are most philanthropic. In every case that we saw the mill villages were clean, the houses were in good condition, the operatives were happy and contented, and were being looked after by the management as well, and probably better, than they could have looked after themselves. In the mills the scheme of production is following fairly rapidly that of the New England mills; in fact there is a great tendency for the New England mill owners to build a mill in the South and overcome the difficulties of mixed labour that they have in the North. We were told that we would see negroes and children working in the Southern mills but that is a big mistake. A white man will not associate with a negro at all in the South, and the control of child labour, not by any Statutes, I think, but by mutual consent, is such that there are no young persons employed at all. Their production costs are considerably less in the South owing to the simpler life the operatives lead. They do not, of course, earn such high wages, because they have not increased their efficiency by piece rates and splitting up of production to the extent as the North has done, but they are a considerable source of competition to the North.

In conclusion, I wish to endorse what Professor Morton has said. The kind way in which we were received almost made us blush. You had practically only to turn up on a doorstep and they would greet you, invite you in and put you up for the night. The people there are always having conventions, and they go to great pains to attend them all, and they discuss their views with great freedom. As soon as a man has a new idea he goes and tells his neighbours about it at a convention, while he himself receives perhaps a dozen new ideas from other speakers, so that the exchange is a profitable one from his point of view.

Mr. John Crompton, in proposing a vote of thanks to the lecturers, said that what had been told them brought vividly to mind things that he himself saw in the States some years ago in company with Mr. Greg, Senr. There was ample food for thought in what had been told them. With regard to the exchanging of ideas at conventions which had been referred to, this was a system which the Textile Institute were really endeavouring to adopt by the holding of their luncheon-hour meetings. If there was a free interchange of opinions at such meetings then some of the objects for which the Institute was established would be achieved. It was very interesting to learn that their American friends went to the colleges for their foremen. It was quite correct to state that the trade unions in America were not so strongly established as those in Great Britain. It was necessary for both employers and trade unions to work together in harmony for mutual benefit, and then the workmen would receive the full measure of reward for their labour.

Mr. Fielden briefly seconded the vote of thanks, and it was carried by acclamation.

Yorkshire Section

Meeting held in the Council Chamber, Town Hall, Bradford, 7th October 1926, The Mayor of Bradford (Alderman Joseph Stringer) presiding.

ADDRESS ON SOME MODERN ASPECTS OF TRADE AND INDUSTRY

By the Rt. Hon. PHILIP SNOWDEN, P.C., M.P.

Having been introduced by the Chairman, Mr. Snowden said he proposed to speak on some of the wider aspects of trade and industry. He did not bring them a panacea, the immediate application of which would restore trade and ensure prosperity. It might be profitable, however, to consider the principles upon which rested industrial prosperity. There was a feature of the present industrial and economic situation which was perplexing students of the subject. There had been for some years a registered number of unemployed never below

1,000,000; wages had declined in the aggregate by £500,000,000 a year from the peak figure of 1920; the export trade was only three-quarters of the pre-war figure. Yet, in spite of this, the general standard of living was probably never higher, except during a brief period of the war. The amount of money spent in amusements and upon holidays was increasing; 30,000,000 people attended cinemas every week; there were over 2,000,000 homes with wireless installations. These expenditures were recent developments. The figures of savings banks, building societies, sales and membership of co-operative societies were expanding. The profits of retail stores were never higher than to-day. One firm manufacturing cheap motor cars was turning out a new car every two minutes of the working day. The country was being covered by a network of motor 'buses, and tens of millions of people were patronising that means of locomotion. The amount of expenditure on drink, though the amount of liquor consumed was less, was twice the 1914 figure. What was the explanation of the paradox? Unemployment was confined in the main to three or four of the great export trades. He did not think the unemployment figure was very greatly in excess of the actual number of unemployed at times of severe depression in pre-war days. The cost of living had fallen from the peak figure of 325 points to 74 points, and if they took industry as a whole they would find that the reduction in wages had approximated very closely to the reduction in the cost of living. That applied in particular to the two classes of unemployment known as sheltered industries and unskilled labour. What was the explanation of this obvious higher and better standard of living? It was to be found in the fact that in recent years there had been large grants from public sources towards certain social services. The working class was being helped in this way to the extent of £164,000,000 a year.

Proceeding, he said the huge sum of £308,000,000 per year was being paid in interest in War Debts, and this was, in fact, a transference of purchasing power. It was robbing Peter to pay Paul, but the fact remained that the Peters and the Pauls were to a very large extent the same people. There were two powerful and serious economic arguments against the interest on the War Debt. The first was that the interest on this debt went in the main to the people who would not spend it on the patronage of the staple industries of the country—it went mostly to the luxury trades. The other argument was that the War Debt lowered national credit, kept up the price of new capital, and was a detriment to trade and industry. Anything that could be done to increase the purchasing power of the people of this country was a direct encouragement and stimulus to trade.

Turning to the depression in the export trade, Mr. Snowden said that for the last eight years it had been a matter of constant surprise to him that, bad as our foreign trade had been, it had not been infinitely worse. The four main causes of the depression were—(1) the decreased purchasing power of the countries that were formerly the customers of the manufacturing nations; (2) the political instability which had followed the war; (3) the exchanges; and (4) the want of capital. Alluding to the return of the gold standard, he said he thought it was done too hastily, and this was not good for a country. The deflation was carried out too rapidly. These were some of the temporary and, he hoped, passing influences which were preventing the recovery of world trade. Dealing with what he described as influences of a more permanent character, Mr. Snowden said we could no longer hope or expect that Great Britain would have a monopoly of the world's trade. Other countries were becoming industrialists, and were dealing with the manufactures that needed no great amount of technical skill. Great Britain would have to rely very largely for its foreign trade on devoting energy and enterprise to the production of high-class goods. An examination of the table giving the exports per head from the United Kingdom to the countries of the world showed a striking disparity between the volume of goods purchased by these countries. It was the countries with a high standard of living which were our best customers. The fact that the British Colonies were our best customers was not alone due to the fact that they were our own kith and kin. Two other

reasons were that they had borrowed largely from the home country, and their exports were to a considerable extent the payment of interest on these loans; and that they had a high standard of living.

Mr. Snowden went on to point out the increase in the volume of world trade that would result from the raising of the standard of living in such countries as India, China, and Africa. In regard to India, he said that the exports were 5s. 3d. per head of the population. If the purchasing power of the nation were raised by a penny per week, India would take £60,000,000 more than she did at the present time. They must look to the countries where the standard of living was still low for the expansion of world trade. They were hardly yet at the beginning of the world trade; it was in its infancy. The development would be comparatively slow, but it could be done. One of the most serious barriers was the tariff. In the last few years, 25 countries had modified their tariff rates and in practically every instance the alteration had been an increase. This was due to the ineffectiveness of tariff barriers to protect the home industry, and to the idea that it was a good thing to make the country into an independent economic unit. The country with a tariff constantly needed to raise the amount of the tariff and that was itself conclusive evidence of its ineffectiveness to attain its object. Tariffs stimulated the competition of world-rivals. The desire to make the country an independent economic unit arose from a delusion. They did not realise that trade was an exchange of commodities. The same delusion was behind the slogan, "Buy British Goods." There was no country in the world where the uttering of a slogan like that was likely to be so disastrous to trade. A statement was made by the President of the Board of Trade recently that every time one bought a foreign article one deprived a British workman of a job.' No statement could be more foolish or more grotesque. Suppose the foreigner took up that position, where would the British export trade be ? He did not think the Governments of this country had done all they might have done in the way of bringing pressure to bear upon other countries to reduce their tariffs. He thought Government action ought to be taken to refuse to let London be an open market for the raising of capital for foreign countries unless some reciprocal advantage was given in the way of a reduction of tariffs. He thought much could be done through the League of Nations and the International Chamber of Commerce to bring about an international reduction of tariffs. The greatest of all the barriers to international intercourse was war. He believed there was going to be trade enough for everybody, but peace at home was vital and essential. "If we are going to have a succession of industrial disputes, there is little hope or prospect of the progress I believe it is possible to realise. The obligation to avoid industrial trouble is not imposed on one side or the other. It is an obligation on both sides. I hope there is a growing appreciation, both amongst workers and employers, for the maintenance of industrial peace, and this can only be done by doing justice all round. The employer must realise that there must be a progressive improvement in the standard of life of the workers, and that it is fatal to try and reduce costs by attacking wages. That is the worst policy that could be adopted.

In conclusion, Mr Snowden said the present coal dispute was due to the inefficient handling and use of coal. We could not have a satisfactory settlement of the coal problem unless we eliminated the waste involved in our present methods of dealing with coal. (Applause.)

On the motion of Mr. John Emsley, seconded by Ald. W. Turner, a hearty vote of thanks was accorded to Mr. Snowden.

Joint Meeting with the Batley and District Textile Society in the Batley Public Library, 30th September 1926: Mr. T. C. Taylor, J.P., being in the chair.

Opening the proceedings, Mr. Taylor said that upon the head of a woollen manufacturer's business rested the responsibility of seeing that a very great variety of processes were competently managed. In their trade, at least, there

was never a piece of cloth which had not to pass through the hands of at least twenty different persons before it got to the merchant. He could not imagine any business in which the team spirit was so necessary as in theirs. The securing of competent managers and foremen for such a variety of departments was itself no easy matter for the head of the concern, and the two qualities necessary in every manager were personal fitness to manage men and technical knowledge. Some men possessed the first of these qualities and others the second, but very few possessed both. While not everyone agreed with him, continued Mr. Taylor, that the profit receivers should share their profits with the workers, there were many firms who took a real interest in their workers, and if they did so the workers knew it. Only if the employer did his best for his workpeople, could he expect them to do their best for him. Employers must make those under them see that it was in their interest to do their duty, and should try to make it their pleasure too. They must employ the heads and hearts of their workers as well as the hands. Recent observers from this country of industrial relationships in the United States appeared to agree on the absence of "ca-canny" in American industry. Employer and employed appeared to co-operate in securing the largest possible amount of production. Real wages were high and there was an absence of "that ignorant and mischievous doctrine that we can get more by producing less." He then asked Mr. G. Garnett, a Vice-President of the Textile Institute, to deliver his address.

After thanking the Yorkshire Section of the Institute for the invitation to speak before this meeting, Mr. Garnett said that in his opinion, and in the opinion of others, we have rested too long on our laurels, and that apart from economic factors, which are more or less international in their effect and, therefore, less controllable by ourselves, other nations were successfully competing with us in securing a much greater proportion of the world's markets than formerly. He therefore proposed for a short while to attempt a brief survey of what was being done at home to meet these external competitive conditions. He first wished to deal with advances in the scientific investigation of industrial problems from, of course, the aspect of the wool textile industry. The underlying principles of technical processes were to a considerable extent known and understood by our forefathers, and a measure of the success they achieved is to be found in the number of people normally employed in the industry, namely, 300,000. Natural facilities, as well as inherent aptitude, had helped them to be first in the field, and though to a great extent these advantages are still our inheritance, they are not in themselves sufficient to keep us in the premier position. In 1918, under the guidance of the Department of Scientific and Industrial Research, the British Research Association for the Woollen and Worsted Industries was formed to deal with pure research, with investigation of specific problems, and to give technical and scientific assistance to members of the Association. Such work had been needed for some time, but it was only by the formation of an association of firms that it was possible to meet the cost. He had no hesitation in saying that the Association had justified its creation and had only to refer to such investigations as "Electricity in Wool," "Causes of Colour Fading," "Standards of Regain," and "Migration of Alkali in Damp Scoured Cloth," to illustrate the important character of the work done and of the information given to subscribing firms. On the mechanical side, the Stroboscope had revealed the irregular speed of spindles, a contributory cause of yarn imperfections, and thrown thereby much light on the causes of faults previously unknown. He felt, too, that of particular interest to the Batley district, would be the experimental carding set now running at Leeds on various types of blends. From this set, mechanical improvements which should have far-reaching results were confidently expected. All this, said Mr. Garnett, involves much work, time, and patience, and could only be continued if it had the whole-hearted support of the trade. The income of the Association would have to be considerably increased in order to comply with the conditions upon which the Government grant was now being given.

To let the work of the Association diminish or die of starvation would be sheer madness, and would be equivalent to leaving the field to our competitors.

Mr. Garnett, proceeding, said that he was confident that an *esprit de corps* was now definitely discernible in industrial life. It was eminently desirable that those engaged in industry should be imbued with a sense of fair play, should recognise the rights and privileges of others, and should believe firmly in joint action for the common weal. Such a spirit he felt now definitely animated industrial life and found practical expression in the welfare schemes with which all would be familiar. The establishment of dining rooms, sports grounds, savings clubs, and pension schemes, all served to prove that those in control of our big industries realised the value of anything that might bring into closer contact all sections of masters and men. Such movements as those of the boy scouts and girl guides played their part both in industrial and in civil life in helping those concerned to realise the value of team work. Not only did these considerations make for greater personal efficiency and better quality of work, but they resulted in a fuller knowledge of others, coupled with a sense of inter-dependence and a recognition of the value of co-operation. Speaking of the development of trade unionism in industry, Mr. Garnett said that though the trade union must be recognised as an integral part of the constitution of industry, he was afraid that trade unionism had developed upon lines destructive rather than constructive. It cherished prejudices directly contrary to that spirit of fair play and mutual confidence for which he was pleading. Both Capital and Labour appeared to wish to divert attention from their own faults by over-emphasising the faults of the other side, and it was not until both sides would look their own faults plainly in the face that industry would be relieved of the dead weight of mutual suspicion and mistrust. He referred to the different state of affairs in the United States, but said that he hoped in this country we should go further—as was, he thought, our habit—and achieve a wider perfection.

The grant of a Royal Charter of Incorporation to the Textile Institute, said Mr. Garnett, may be said to have marked the beginning of a new era in textile technological qualification. Under the Charter, a diploma scheme was in course of establishment and members of the Institute whose qualifications were accepted as satisfying the requirements of the Institute's bye-laws might receive Diplomas of Associateship or Fellowship of the Textile Institute. In brief, this meant the creation of a new post-graduate qualification and distinction. This should prove a powerful incentive to young men in the industry to continue their training and not to mark time in relation to textile technology during their early years in the textile industry. He was pleased to say that Mr. J. H. Lester, Chairman of the Selection (Diplomas) Committee of the Institute, was present, and would deal at greater length with the scheme. In conclusion, he wished to re-emphasise that in his belief the lines of development along which the industry should make every effort to progress were those of scientific research, of closer co-operation and mutual goodwill between all concerned, and of higher technological qualification.

Mr. Lester, being called upon to address the meeting, described in detail the methods by which the diplomas of the Textile Institute could be obtained and paid a tribute to the work of Mr. John Emsley in obtaining the Royal Charter for the Institute. The textile technologist, he said, was someone acquainted not only with the science but with the art of textile manufacture. It was a case of the combination of theory and practice, and they did not say the one or the other was supreme. The industry in the past had been built up, not on science, but on art, on rule-of-thumb, on the cleverness of their forefathers. They would be unwise to abandon that heritage and to submit to the dominance of science. Describing the "royal road" to Associateship of the Institute by way of the universities, Mr. Lester said that unfortunately few of their students could enter the door to the university even after passing the matriculation examination. Though they might obtain a County Council grant which would provide for their

fees, they had not always the means of obtaining the necessary money for their maintenance. It was, he thought, a disgrace to the country that so small a proportion of the poorer members of the community could possibly obtain scholarship and maintenance grants to enable them to go forward to the universities. He felt that the textile industry to-day was not in a healthy condition and he was not inclined to be optimistic for the future. The student of to-day by no means utilised, as he might, the facilities that were provided for him and that enabled him to lift himself above the common level. Moreover, with many notable exceptions, it must be admitted that as regards the directorate and management of by far the larger part of the mills, the training which the heads of the concerns had received was not such as they should really have had.

Mr. John Emsley, referring to his own work for the Textile Institute, said that any man who had benefited by his industry ought to put something back into the industry. It had been a privilege to him to have been able to take part in the securing of the Charter. Unlike Mr. Lester, he was rather optimistic. We had had what was really a revolution in this country; we had had to decide whether we should be ruled by order or by mob law, but when we got over these troubles there was a great future for this country. The spirit between man and man would be better, and both employers and employed would benefit.

The interesting discussion which followed was terminated by a vote of thanks to the speakers, proposed by Mr. C. Varley and seconded by Mr. N. B. Radcliffe.

South of Scotland Section

Meeting at the Technical College, Galashiels, on Thursday, 30th September 1926.

ARTIFICIAL SILKS—PREPARATION AND PROPERTIES

At this meeting, Mr. Ninian Kemp occupied the chair, and there was an excellent attendance, considerable interest being evinced in the special display of yarns and fabrics which had been secured by the Institute. Exhibits had been kindly lent by Mesrs. Courtaulds, Ltd., and the Celanese Company, whilst a general collection was forwarded by Mr. P. E. King, of the Department of Dyeing, Leeds University. Exhibits of fabrics showing cross-dyeing effects were supplied by the Research Department of the Bleachers' Association. The interest in the display was so marked that the collection was allowed to remain available for inspection for a few days.

The Chairman, introducing the lecturer, Dr. J. C. Withers, of the British Cotton Industry Research Association, said he was sure everyone there would be anxious to hear what Dr. Withers had to say in regard to this important development in the textile industry. He than asked Dr. Withers to address the meeting.

The Lecturer explained that whilst most of the many valuable papers which had been read before audiences of textile workers during the past few years dealt exclusively with dyeing or emphasised the merits of the products of a particular firm, he would attempt to give a review of the whole field and discuss such ascertained properties of the various artificial silks as were important in their application or would serve to distinguish one from another. After a short historical introduction, he gave an outline of the processes underlying the manufacture of the four main types, namely, Chardonnet, cuprammonium, viscose, and cellulose acetate silks, pointing out those stages which require careful control and which profoundly affect the quality of the final product. He explained that the first three types are really cellulose, differing considerably in physical properties, but only slightly in chemical properties, from cellulose as found in well-scoured cotton, whereas cellulose acetate silk is chemically quite distinct, being a compound.

Dr. Withers then explained the denier system of counts and gave examples of the wide range in the number and dimensions of single filaments in threads

of about the same counts, showing that the appearance and feel of real silk are more nearly approached by threads composed of very many slender filaments. He then reviewed what was known of the microscopic appearance, tensile, optical, and other properties, quoting largely from the published researches of the Forschungs Institut für die Textilindustrie, Dresden. It was explained that certain measurements made on cross-sections can be used as a distinguishing test between artificial silks, whilst the actual outlines of the sections often afford a clue to the nature of the spinning baths used in their manufacture. More simple chemical and physical tests were summarised. Moisture regain and the serious effect of moisture on the tensile properties of artificial silk were also discussed.

Difficulties in sizing, winding, and weaving were briefly mentioned, and it was explained that defects due to variable tension are magnified enormously with such lustrous materials. Actual examples of lustre faults in fabrics were exhibited, and the use of photography and the microscope in examining them was described. Finally, brief references were made to the dye affinities of the various types.

On the motion of Mr. R. S. Hayward, Dr. Withers was heartily thanked for his services.

The General Secretary of the Institute contributed a short statement in reference to the Institute's Diploma scheme, and moved a vote of thanks to the Chairman, which was carried by acclamation.

CONFERENCE OF REPRESENTATIVES OF TEXTILE SOCIETIES AND KINDRED ORGANISATIONS

Visit to Blackburn Technical College

A conference of representatives of Textile Societies and Kindred Organisations of Lancashire, Yorkshire, and the Midlands, took place at Blackburn Technical College on the afternoon of Saturday, 9th October. Over fifty delegates were present and were welcomed by Mr. J. W. Marsden, J.P., Chairman of Blackburn Higher Education Committee, by Mr. Charles Tate, President of Blackburn Textile Society, and by Mr. J. H. Dawson, President of Federation of Textile Works Managers' Associations.

Introducing the discussion on "The Work of Textile Societies and its relation to Technical Education generally," Mr. J. H. Dawson, of Brierfield, said that the public spirited organisations represented at that conference exerted a wonderful influence on technical education in regard to the textile industries. The whole atmosphere of textile societies was one of technical education. There were 33 societies represented and the total membership was over 10,000, which certainly indicated the potentialities of the movement. Some of the societies had prepared the soil for to-day's technical education, starting as mutual improvement societies, and leading up to the mechanics' institutions, long before municipalities and Governments thought about the importance of the subject. The ideal remained with these societies and, in nearly every case, their first aim and object was "to further the interests of the textile industry by educational and other means." There was still great opportunity for the societies, and the unselfish character of their work was probably not fully realised by themselves. He believed it was still possible for these organisations to mould the tendencies of technical education of the future. Their endeavour was in the direction of making occupation intelligent and interesting without drift into drudgery. This was what some of the old Textile Craft Guilds engaged in, and he thought some endeavour might be made to resuscitate the spirit of those Guilds and apply it to modern industrialism. A good many young men in the industry were liable, apparently, to reach the state commonly described as "fed-up," whilst at the other end of the scale there were individuals who erroneously considered

their knowledge all-sufficient. If textile societies could remove either of these defects, the achievement would be great. As a matter of fact, the real benefit and interest of technical education only accrued subsequent to class or course instruction. The textile societies provided for continuance of technical education, and since the Textile Institute had set up its post-graduate qualifications, the whole movement was carried forward and achievement in continued technical education could be properly recognised.

Mr. W. Wilkinson (Head of the College) said the textile societies afforded a very necessary meeting ground for those who had received technical training. It was perfectly true that the student who completed the usual courses of training was not even then fully trained. The textile societies, and after that the Textile Institute, provided the avenue of progress.

Mr. W. P. Crankshaw (Bolton) expressed the view that it was not the business of the College to teach a man his job, this being the function of the industry.

The delegates spent a couple of hours inspecting the various departments of the College and their equipment, and on the motion of Mr. Henry Binns (Bradford), seconded by Mr. J. Chamberlain (Leicester), a hearty vote of thanks was accorded to the officials of the College, the Blackburn Textile Society, and the Federation of Works Managers' Associations.

It was decided that the next annual conference should take place in October 1927, and representatives were asked to give their organisations opportunity to offer an invitation to the conference as Blackburn had done on this occasion. Any such invitation should be forwarded to the General Secretary of the Textile Institute, Mr. J. D. Athey.

Some discussion took place regarding framing of syllabuses of lectures, and several representatives alluded to difficulty experienced in securing contributors. Mr. G. S. Leeson (Bradford) urged formation of "Syllabus Committees" definitely responsible for securing the programmes of lectures. The Secretary (Mr. Athey) pleaded for more frequent requests to members of societies to prepare papers, and interchange of services in this connection. Messrs. N. Collinson (Batley), J. Burgess (Ashton), and C. Barnshaw (Blackburn), also took part in discussion, and the proceedings ended with a hearty vote of thanks to the Chairman.

CIVIC WEEK CELEBRATIONS IN MANCHESTER

Manchester engaged in Civic Week celebrations—from 2nd to 9th October—when various institutions contributed in a variety of ways to the programme. In response to request, the Council of the Textile Institute agreed to arrange for a contribution by wireless in reference to the city and the cotton textile industry. Accordingly, on the evening of the 7th October, the President of the Institute, William Howarth, Esq., J.P., broadcast the following statement from the B.B.C. Station—

MANCHESTER AND THE COTTON INDUSTRY

Manchester is the centre of the British cotton manufacturing industry—the largest in the world and, in relation to our export trade, the most important of all British manufacturing industries. The complex commercial activities of this vast industry, and the warehousing, packing, and distribution arrangements are all concentrated here. Raw cotton is brought overseas direct to Manchester via the Ship Canal, and the fabrics manufactured therefrom are shipped to all parts of the world. Lancashire's consignments of fabrics stream out so that the location of the consumer may range from the proverbial "China to Peru." Native races in many climes are abundantly familiar with textiles from Manchester, but they know them by descriptions not commonly known throughout England (Dhooties, Sarongs, &c.). In exceptional cases, goods which are not usually seen in this country except in the process of manufacture, are sent regularly to a particular country where they are traditionally regarded

by the natives as of exclusive character, and the demand for them would be imperilled if the exclusiveness were seriously doubted. Manchester is undoubtedly the leading textile market of the world.

The organisation of the industry may be divided into three main sections—Manufacturing (which comprises spinning and weaving); Finishing (which includes bleaching, dyeing, and printing); and Marketing (at home and abroad). Spinning is mainly concentrated in South Lancashire and adjoining parts of Cheshire and Yorkshire, the fine spinning being centred in the Bolton and Manchester districts, and the spinning of the coarser yarns in Oldham, Rochdale, Wigan, and Stockport areas. The weaving centres are largely in North and East Lancashire—Blackburn, Burnley, and Preston being important districts. Finishing is to some extent a specialised industry in Lancashire, but is also usually combined with the bleaching, dyeing, and calico-printing industries. Enormous progress has been made and continues to be made on the finishing side of the industry, and it is on this side that the greatest advance has been achieved in recent years.

With regard to marketing, although some merchanting houses ship all kinds of cloth to all markets, the majority specialise on one particular market or group of markets. Thus, a business house is said to be in the Far East trade, the India trade, the South American trade, or it might be in the West African trade.

"Cotton wool" was at one time the common description of our raw material, and it was then regarded as a substitute for wool, much in the same way that so-called artificial silk has been regarded as a substitute for natural silk. Our cotton textile industry dates back to the latter half of the sixteenth century. It was not, however, until the middle of the seventeenth century, long after the introduction of the spinning of "cotton wool," that goods entirely of cotton were manufactured here. Importation of cotton goods from India was opposed by the old and strongly-entrenched industries of wool production and manufacture. Tariffs were set up in order to check the importation, but high tariffs and prohibitions appear to have given a stimulus to importation of the raw cotton and to home manufacture. It was mainly the successful spinning of cotton and the development of new and improved methods which enabled formidable headway to be made.

In the modern sense, however, cotton spinning and manufacturing is a comparatively new industry, commencing in the last twenty years of the eighteenth century. At the beginning of the nineteenth century our annual consumption of the raw material was equal to one hundred thousand bales, each of 500 lb. or nearly a quarter of a ton in weight. Large as the figure may sound, yet this quantity would not nowadays keep Lancashire mills running for a fortnight. By 1843, for the first time, the million bales mark was reached. The figure to-day of cotton consumed in this country—from all sources—is placed at well over three million bales per annum, which represents a consumption of over sixty thousand bales a week.

As in the early days achievement in spinning greatly promoted rapid development, so to-day the strength of our position in the world's competitive markets is greatly dependent upon the maintenance of supremacy in this section and of the high efficiency in the manufacture of fine cotton goods. The fact that approximately four-fifths of the world's mule spindles—the best instrument for the production of super yarns—are to be found in Lancashire, is a sufficient indication of the situation with regard to the production of fine cotton goods. Approximately, a quarter of the British cotton spinning industry depends upon Egypt for its supply of raw cotton of long staple. America still supplies the great bulk of the cotton required, but supplies of Empire-grown cotton are now regularly on the market, and increasing efforts are being directed to developments in this direction. Long-stapled cotton is essential for the fine counts of yarn in the spinning of which Lancashire stands pre-eminent. As the industry continues to develop in foreign countries, it is regarded as quite certain that

competition in the world's markets will become keener and keener, and will take a wider and higher range, with the result that Lancashire trade must tend towards a still greater proportion of fine spinning and the manufacture of cloths from yarns of fine count. The hope is that with world-wide advances in the standard of living the demand for finer goods will correspondingly increase. The adaptability of the industry to change of conditions inspires confidence as to its future—an adaptability proved, for instance, by the rapidity with which it has utilised artificial silk, and by the manner in which some districts have effected changes in the character of their productions in order to overcome difficulties of dislocation of trade and markets following the great war.

There are over half-a-million of insured persons in our manufacturing industry. The spindles number approximately 59 millions, or one-third of the world's total, whilst looms number 800 thousands. Normally, about 80% of the cotton fabrics produced are for shipment. Last year (1925) the exports of yarn exceeded 189 million pounds in weight. Of cotton cloth over 4½ thousand-million square yards were exported—an amount which, if converted into a continuous web, would provided a cotton bandage 100 yards in width right round the world. The figure of 4½ thousand-million square yards for 1925 compares unfavourably with 1913, when it was 7 thousand-millions, and it emphasises the severity of the trade depression of last year.

In addition to the manufacturing industry, the development of the British textile machinery industry has been remarkable. Just as Britain is the largest producer of textiles, so she is the largest manufacturer of textile machinery. It has been an enormous advantage to the industry that the engineering establishments have been developed in proximity to the mills, thus admitting of effective co-operation between machine maker and user. The annual export of textile machinery from Lancashire provides a substantial quota to the total value of the exports of this country.

Organisation as to trade and commerce of the industry has reached a high pitch of efficiency. The general organisation, however, is remarkable for the extent of its ramifications and the energy with which the various interests are pursued. The comparative freedom from industrial disputes, particularly in the very difficult post-war period, is high testimony to efficiency of control on the sides of both employer and employed.

Technical education has progressed rapidly. The modern movement of especial interest in this connection has been that of continued instruction long after entry into the industry. Indeed, the organisation to-day offers facilities for the maintenance of absolutely continuous interest in the technical problems of the industry. An indication of the progressive spirit which pervades the rank and file of the cotton industry is to be found in the number of textile societies, managers' associations, and other organisations, one or more of which exist in every important locality and which have for their object the promotion of a wider knowledge of the particular branch of the industry in which members are employed. These organisations, which have no real parallel in any other of our great industries, in addition to preserving existing technical skill, play a great part in the rapid dissemination of new knowledge.

The scientist and the technologist are being more and more employed. Moreover, the industry supports the largest of the co-operative research associations in the country—at the Shirley Institute, Didsbury. Many private concerns, too, maintain individual research departments. The Textile Institute, of which I am the President at the present time, and the headquarters of which are at Manchester, seeks to bring together to one common platform the technological and the scientific interests of the whole of the textile industry. This Institute promotes meetings and conferences for the reading of papers of technical and scientific interest, and also issues a journal which is regarded as the leading scientific periodical devoted to textiles.

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Finally, it may be said for the cotton industry, that its gigantic output, its stupendous capital, and its strength of position in international trade, all combine to place it in the first rank of British manufacturing industries.

NOTES AND NOTICES

The Textile Society Movement

In the interests of technical advancement, the potentialities of the movement which has resulted in the establishment of textile societies and kindred organisations in the various areas of the textile industry are obviously great, when the numerical strength of the organisations is fully revealed, as was the case at the conference of representatives of these organisations which took place at Blackburn Technical College on Saturday, 9th October. A few years ago the Textile Institute, appreciating the efforts of the Societies, initiated a movement for the bringing together of the various organisations with a view to co-operation and discussion for mutual benefit. It may certainly be said that the movement has grown and an annual conference is now an established event. The Institute continues direct association with the movement, undertaking the secretarial work of the conferences, and bearing the incidental expenses. At the conference at Blackburn, Mr. J. H. Dawson, of Brierfield, President of the Federation of Textile Works Managers' Associations, opened a discussion on "The Work of Textile Societies and its Relation to Technical Education." It was characteristic of Mr. Dawson, as his utterance indicated, that he should have spared neither time nor effort to secure reliable information. By direct communication with the officials of all the organisations he had obtained first hand knowledge of their activities, objects, and numerical strengths. It was surprising to learn that the organisations represented at the conference had a total membership of 10,000, all of whom might be said to be interested in the technical advancement of the industry. The movement is probably on a scale without parallel in industry. The 1927 conference is to take place in October next and the General Secretary of the Institute would be pleased to receive, on behalf of the movement, any invitation on the part of a participating organisation, or from any textile teaching institution which might be visited in conjunction with the conference.

London Section Activities

The London Section, which started to arrange its winter programme somewhat later than usual, has already obtained the promise of several interesting papers. Among these must be mentioned "Development of Bast and Leaf Fibre Cultivation in the British Empire," by Dr. Goulding, of the Imperial Institute; "Fabric Testing for Retail Distribution," by Mr. W. C. Whittaker, who for many years has controlled the testing department of one of the largest west-end stores; "Flax Markets," by Mr. E. Wigglesworth; "Standard Lancashire Cloths," by Mr. A. R. Down; "Household Linen," by Mr. D. Anthony-Langsdale; and a paper on weaving faults, by Mr. L. J. Mills. Other functions which it is proposed shall take place are a visit to the Imperial Institute for the purpose of viewing the textile exhibits, a visit to a rope-walk, and a dinner-dance on the evening of the day of the Annual London Section Meeting. In all probability at least two of the papers will be read in the Clothworkers' Hall, by kind permission of the Clothworkers' Company. The courteous attitude of this great Livery Company, which for the past three years has generously placed its magnificent hall at the service of the London Section for certain lectures, provides a small but not unimportant illustration of the consistent present-day benevolence of the Clothworkers' Company to the industry of which at one time it was the governing body and guardian.

Section Meeting at Belfast

With a view to resuscitation of sectional activity in the area of which Belfast is the centre, a meeting of members of the Institute took place at the Technical College, Belfast, on the 16th September. Mr. W. H. Webb, of Randalstown, was voted to the chair, and there were also present Messrs. F. Anderson, F. J. W. Shannon, G. R. Beatty, R. V. Eves, W. H. Gibson, F. Bradbury, O. V. Greeves, J. Kirkwood, W. J. Cowden, and others. The General Secretary (Mr. Athey) attended and stated that it was the desire of the Council that a small Committee to engage in Section activities should be appointed. It was suggested that at least two meetings for the delivery of papers, with discussions to follow, should be arranged for the oncoming session, whilst members of the Section might possibly hold a meeting of a social character with a view to bringing members together. The Secretary also offered a statement with regard to the Institute's Diplomas, and explained at length the scheme of post-graduate qualifications to members and the conditions attached thereto. On the motion of Mr. Anderson, seconded by Dr. Gibson, it was decided that a Section Committee be appointed, together with an Hon. Secretary, in order to promote meetings. It was decided that the Committee be constituted as follows—Messrs. W. H. Webb, Dr. Gibson, F. Anderson, F. Bradbury, Jas. Crawford, F. J. W. Shannon, W. J. Cowden, G. R. Beatty, and J. Kirkwood. Mr. F. J. W. Shannon was unanimously elected Hon. Secretary, and the meeting was concluded with a vote of thanks to the Chairman and to the Institute Secretary.

The Textile Institute Annual Conference

Our report of the proceedings of the above-named Conference—held at Buxton (Derbyshire), 20th to 22nd October—will appear in the next issue of the Journal. The event has been postponed from last Whit-week owing to the general strike, which immediately preceded that week. Deferred events usually suffer, and if the attendance at Buxton was not quite up to the average, nevertheless it was indeed fortunate that the programme of lectures was available substantially in the form in which it was originally framed, Sir William Bragg kindly renewing his engagement to deliver the Annual Mather Lecture of the Institute.

Diplomas of the Textile Institute

Applications for the Associateship of the Institute have already necessitated the conduct of two oral examinations in General Textile Technology, the Selection Committee having insisted upon a satisfactory level of knowledge covering the whole field of textile technology in addition to attainment in a particular branch or in special branches. The Committee's experience of the examinations held suggests that the stipulation in regard to a satisfactory knowledge of general textile technology has not only been justified, but that it will need to be rigorously maintained. Indeed, the Selection Committee has recently considered the matter of the preparation of regulations and a syllabus to be issued in relation to future examinations of this character, and a special Sub-committee has been appointed to canvass the whole question, prepare a scheme, and report in due course to the Committee.

Research Directorship Change

The resignation has recently taken effect of Mr. H. J. W. Bliss, Director of Research for the British Research Association for the Woollen and Worsted Industries, the activities in connection with which are centred at Headingley, Leeds. Mr. Bliss had been for several years past in close and direct touch with the affairs of the Textile Institute, and his services were greatly appreciated. An announcement issued by the Association in question, states that following repeated misfortunes which have befallen the family of Mr. H. J. W. Bliss, M.A., F.I.C., he has asked the Association to receive his resignation, as he feels that a break with painful local surroundings would be in the best interests not

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The London Section, which started to arrange its winter programme somewhat later than usual, has already obtained the promise of several interesting papers. Among these must be mentioned "Development of Bast and Leaf Fibre Cultivation in the British Empire," by Dr. Goulding, of the Imperial Institute; "Fabric Testing for Retail Distribution," by Mr. W. C. Whittaker, who for many years has controlled the testing department of one of the largest west-end stores; "Flax Markets," by Mr. E. Wigglesworth; "Standard Lancashire Cloths," by Mr. A. R. Down; "Household Linen," by Mr. D. Anthony-Langsdale; and a paper on weaving faults, by Mr. L. J. Mills. Other functions which it is proposed shall take place are a visit to the Imperial Institute for the purpose of viewing the textile exhibits, a visit to a rope-walk, and a dinner-dance on the evening of the day of the Annual London Section Meeting. In all probability at least two of the papers will be read in the Clothworkers' Hall, by kind permission of the Clothworkers' Company. The courteous attitude of this great Livery Company, which for the past three years has generously placed its magnificent hall at the service of the London Section for certain lectures, provides a small but not unimportant illustration of the consistent present-day benevolence of the Clothworkers' Company to the industry of which at one time it was the governing body and guardian.

Section Meeting at Belfast

With a view to resuscitation of sectional activity in the area of which Belfast is the centre, a meeting of members of the Institute took place at the Technical College, Belfast, on the 16th September. Mr. W. H. Webb, of Randalstown, was voted to the chair, and there were also present Messrs. F. Anderson, F. J. W. Shannon, G. R. Beatty, R. V. Eves, W. H. Gibson, F. Bradbury, O. V. Greeves, J. Kirkwood, W. J. Cowden, and others. The General Secretary (Mr. Athey) attended and stated that it was the desire of the Council that a small Committee to engage in Section activities should be appointed. It was suggested that at least two meetings for the delivery of papers, with discussions to follow, should be arranged for the oncoming session, whilst members of the Section might possibly hold a meeting of a social character with a view to bringing members together. The Secretary also offered a statement with regard to the Institute's Diplomas, and explained at length the scheme of post-graduate qualifications to members and the conditions attached thereto. On the motion of Mr. Anderson, seconded by Dr. Gibson, it was decided that a Section Committee be appointed, together with an Hon. Secretary, in order to promote meetings. It was decided that the Committee be constituted as follows—Messrs. W. H. Webb, Dr. Gibson, F. Anderson, F. Bradbury, Jas. Crawford, F. J. W. Shannon, W. J. Cowden, G. R. Beatty, and J. Kirkwood. Mr. F. J. W. Shannon was unanimously elected Hon. Secretary, and the meeting was concluded with a vote of thanks to the Chairman and to the Institute Secretary.

The Textile Institute Annual Conference

Our report of the proceedings of the above-named Conference—held at Buxton (Derbyshire), 20th to 22nd October—will appear in the next issue of the Journal. The event has been postponed from last Whit-week owing to the general strike, which immediately preceded that week. Deferred events usually suffer, and if the attendance at Buxton was not quite up to the average, nevertheless it was indeed fortunate that the programme of lectures was available substantially in the form in which it was originally framed, Sir William Bragg kindly renewing his engagement to deliver the Annual Mather Lecture of the Institute.

Diplomas of the Textile Institute

Applications for the Associateship of the Institute have already necessitated the conduct of two oral examinations in General Textile Technology, the Selection Committee having insisted upon a satisfactory level of knowledge covering the whole field of textile technology in addition to attainment in a particular branch or in special branches. The Committee's experience of the examinations held suggests that the stipulation in regard to a satisfactory knowledge of general textile technology has not only been justified, but that it will need to be rigorously maintained. Indeed, the Selection Committee has recently considered the matter of the preparation of regulations and a syllabus to be issued in relation to future examinations of this character, and a special Sub-committee has been appointed to canvass the whole question, prepare a scheme, and report in due course to the Committee.

Research Directorship Change

The resignation has recently taken effect of Mr. H. J. W. Bliss, Director of Research for the British Research Association for the Woollen and Worsted Industries, the activities in connection with which are centred at Headingley, Leeds. Mr. Bliss had been for several years past in close and direct touch with the affairs of the Textile Institute, and his services were greatly appreciated. An announcement issued by the Association in question, states that following repeated misfortunes which have befallen the family of Mr. H. J. W. Bliss, M.A., F.I.C., he has asked the Association to receive his resignation, as he feels that a break with painful local surroundings would be in the best interests not

only of himself, but also of the organisation of which he had been Director of Research since its inception. These circumstances are well known to many in the West Riding. The Research Control Committee greatly regret that under the circumstances they find themselves with no alternative but to accept Mr. Bliss' resignation. They are anxious that it should be understood that they hope and expect Mr. Bliss will obtain an appointment of a suitable character elsewhere, and they will give him all the assistance in their power. Sir James P. Hinchliffe and Mr. Henry S. Clough referred at some length to the spade work which had been done under Mr. Bliss' direction and to the fact that the Association has now become an effective force in the trade. Mr. Bliss expressed his personal thanks to all members of the Council and Committee for their unvarying courtesy and support. He much regretted the necessity of leaving the service of the Association but had the satisfaction of knowing that work in all its branches was proceeding smoothly, and that many important results are within sight. Dr. S. G. Barker, D.I.C., A.Inst. P., head of the Association's Physics Department, has been appointed to succeed Mr. Bliss as Director of Research.

Cotton Growing in Uganda

Sir William F. Gowers, Governor of Uganda, was the principal guest at a luncheon given by the British Cotton Growing Association at Manchester on the 5th October. Lord Stanley presided and commended the work of Sir William Gowers, whose appearance in Northern Nigeria coincided with the beginning of the work of the Cotton Growing Association in that country.

Sir Wm. Gowers emphasised the importance of Africa as a consumer as well as producer, but said there must of course be production to secure consumption. Fortunately cotton was probably the best single crop on which Uganda could rely. In 1911, some 9,000 bales were produced and there was steady increase up to the war. By 1921, the output was 47,000 bales; in 1924 the yield was 124,000, and 196,000 in 1925. There was a larger acreage in 1926, but climatic conditions were unfavourable. Up to end of August the amount was 170,000, and the total should reach 180,000. He must admit the danger of the drop in price of American cotton, which would be disappointing to the native in Uganda. The probability was, however, that in the long run it would pay the Uganda native better to grow cotton than any other crop, though it might take him the longer to realise the fact if prices remained at a low level. He (Sir William) believed it was possible for the Protectorate to supply 500,000 bales of cotton per annum, and even within four or five years 350,000 bales might be reached.

Institute Membership

At the September meeting of the Council of the Institute, the following were elected to membership—D. N. Aspden (Warehouse Master), Binnyston Gardens, Bangalore City, India; Christopher Barrow (Technical Chemist), 37 Rowland Street, Beswick, Manchester; Harry D. Belland (Superintendent), Dominion Textile Co. Ltd., Dominion Cottons Branch, Verdun, Quebec, Canada; Benno Borzykowski (President of Borvisk Company), 78 Rue de Provence, Paris, France; Thomas E. Craven (Textile Instructor and Lecturer), 83 Grafton Road, Keighley; Howell K. Hallett (Cotton Manufacturer), Kendall Mills Inc., Paw Creek, N.C., U.S.A.; John Kenyon (Mill Manager), The Villa, Green Lane, Leigh; Joseph McIsaac (Principal, Textile School), Wilts. County Textile School, Trowbridge, Wilts.; Benjamin Musgrave (Yarn Merchant and Agent), Wensley Villa, Fagley, Bradford, Yorks.; Pierre Leblan (Cotton Spinning Mill Manager), 87 Rue de Lannoy, Lille Fives, France (Nord) ; Henry O. Richardson (Works and Analytical Chemist), Ashworth House, Ashworth Road, Dewsbury, Yorks.; E. R. Scragg (Silk Textile Machinist), c/o Ernest Scragg & Sons, Ltd., Macclesfield; H. Sutcliffe Smith (Executive Director, Bradford Dyers' Association, Ltd.), Ingerthorpe Grange, Markington, near Harrogate; Frank Stoyle (Chief Chemist), c/o The Bulmer Rayon Co. Ltd., Stowmarket, Suffolk; Zoltan Szaloki (Assistant

Textile Professor), 1 Karap utca 13, Budapest, Hungary; W. Arthur Turner (Secretary), The Worsted Spinners' Federation, Ltd., 20/26 King's Arcade, Bradford, Yorks.; Alfred Wilman (Silk Noil Spinner and Manufacturer), Station Mills, Hadfield, near Manchester; Harold L. Johnson (Hosiery Manufacturer; in charge of Cutting Department), 3 Gedling Grove, Nottingham; Charles J. Wright (Assistant Chemist), 44 Kilnside Road, Paisley, Scotland; A. L. Patterson (Research Physicist), Kaiser Wilhelm-Institut fur Faserstoffchemie, Faradayweg 16, Berlin-Dahlem, Germany.

COMMUNICATION

To the Editor

"The Hygroscopic Properties of Colloidal Fibres and their Relation to Technical Processes"

Sir

In the August number of the *Journal of the Textile Institute* (P137) there appears the report of a paper read at the recent meeting of the British Association by Messrs. Barker, Hirst, and King, in which it is stated that the authors "Presented a paper . . . in the course of which the theory of elasticity of colloidal fibres was developed." May I be allowed to point out that this wording is misleading ? It implies that the paper is an original contribution to the theory of fibre elasticity (or an account, at least, of the authors' previously published original work), whereas the theory described by the authors was put forward and developed by me more than two years ago.[1,2] The omission of any indication that this portion of the paper is not the authors' own work is regrettable since it may lead to wrongful attribution in other journals.

There is another point which calls for comment. The authors attempt to correlate the various phenomena (elasticity, heat of wetting, swelling, &c.) and arrive at the conclusion that they "are explained by assuming the keratin substance of wool to be of the type of structure observed in dried gelatin jellies, rather than to the surface area or due to any grosser heterogeneous structure such as would be involved in the individual cells of scales or cortex, or the easily observable pores found by Mark."

So far as the elastic properties are concerned, this conclusion is extremely dubious. It is true that a fine-grained heterogeneity is capable of giving rise to the peculiar "elastic after-effect" exhibited by fibres, but it by no means follows conversely that any particular instance of the effect is necessarily due to the fine-grained heterogeneity. My theory postulates a heterogeneity which is most simply described in terms of an elastic and a viscous phase, and makes no attempt to specify more closely the precise nature of the phases. A general theory of fibre elasticity can do no more than this, since different fibres show such great differences of structure. Thus the cotton hair is quite different biologically from the wool fibre; and a filament of artificial silk has no visible structure at all. Further research may reveal new facts by means of which the theory can be developed further for specific fibres, but it is highly probable that the line of development will be different for each fibre.

The evidence available at present points to the physical properties of the wool fibre being dependent upon a heterogeneity more complex than that of gelatin jelly. The two-phase theory has been recently applied to the study of the elastic properties of rods of gelatin jelly by Poole[3] who shows that such rods when loaded extend in a manner characteristic of the most simple conceivable type of two-phase system. As I had shown previously, the mode of extension of a wool fibre indicates a complex type of heterogeneity. Moreover the viscous phase itself behaves as a gelatinous fluid, and may possess a complex structure.

The above considerations throw considerable doubt on the above conclusion put forward by Barker, Hirst, and King, and indicate that it is by no means

safe to neglect the "grosser heterogeneous structure" of fibres. In the case of the wool fibre a more elementary consideration is that a wool fibre is far from being perfectly soluble in boiling water.

REFERENCES

[1] Shorter, Journal of the Textile Institute, 1924, **15**., T207.

[2] Shorter, Contribution to the General Discussion held by the Faraday Society and the Textile Institute on Physical and Physico-Chemical Problems relating to Textile Fibres. Trans. Far. Soc., 1924, **20**.

[3] Poole, Trans. Faraday Society, 1925, **21**. 114.

Didsbury, 20th September 1926. S. A. Shorter.

AUTHORS' REPLY

By the courtesy of the Editor we have seen Dr. Shorter's criticism of the report of our paper, and are surprised that he has thought fit to use for criticism a brief note of the paper, when he has neither seen the original in extenso, nor was he present at the British Association meeting. In the original paper, which is now in the press, we have duly acknowledged authorship of every point both in the text and in the bibliography.

With regard to the scientific criticisms raised, we feel that our complete paper, when published, will be the most effective reply.

Leeds, 2nd October 1926.

S. G. Barker.
A. T. King.
H. R. Hirst.

REVIEWS

The Finishing of Woven Fabrics. By Roberts Beaumont, M.Sc., M.I.Mech.E. Scott, Greenwood & Son, London. Price, 15s.

The publication of a second edition of this work is a tribute to its excellence. Since the late Roberts Beaumont originally wrote this book, a considerable amount of investigation and research has been undertaken. New knowledge had been obtained in respect to the crabbing, lustring, and finishing of wool fabrics; detergents and agents used for scouring and milling, and also in respect to the properties of wool fibres. New theories regarding the phenomena of fibre movements and wool felting during wet finishing processes have been advanced. It is pleasing to note that these matters have been thoroughly considered and dealt with. The new publication in addition to being completely revised contains two new chapters, this having been done very efficiently by Mr. Alex. Yewdall, of the University of Leeds. The work is well written and illustrated, and provides an excellent treatise on the theory and practice of cloth finishing. —E.M.

Handbook of Weaving and Manufacturing. By Henry Greenwood. Published by Pitman & Sons, Ltd. (124 pp. and Index. 5s. net).

The contents of this small treatise indicate its very wide scope, for it treats of the subject of weaving and, in fact, of all other allied subjects literally from A to Z, and in alphabetical order after the manner of a dictionary or encyclopedia. Some idea of the scope of this book will be gathered from the following items, which are a mere fraction of those given in the complete contents—"Yarn and Cloth Calculations; Types of Yarns; Conversion Tables; Loom Drafts; Tie-ups and Peg Plans; Details of all Manufacturing Machines, with notes on Mill Driving; Humidifying; Maintenance of Hygrometers; Ventilation; Fire Appliances; Useful Tables," &c. In a very short Preface, which is a model of brevity, the author says—"This small treatise endeavours to put in concise form, practical information suitable for students, weavers, overlookers, managers, and others engaged in the textile industry," and concludes with the hope "that the practical information contained in this book will be of use to the industry, and fill a gap in modern textile literature."

The book certainly contains a vast amount of information and useful data, but its description as a "treatise" is a misnomer inasmuch as it does not expound or "treat" of the various subjects after the manner of a class text-book. In the present volume, the various subjects are arranged in a more or less haphazard manner, so that it assumes somewhat of the composite character and style of the "Useful Compendium" or "Handy Book of Reference." The subject matter, too, is so very concise and condensed, and written in many instances in such a loose style of phraseology as oftentimes to defeat the author's aim. For though brevity is a commendable feature, still clarity of expression should not, especially in a "treatise" for students, be sacrificed to mere brevity. Information for students should be explicit and accurate, not vague or inaccurate as, unfortunately, is the case in several instances in the book under review. For example, on page 3, a type of artificial silk is given as "Viscous" instead of "Viscose"; nor is it a fact that "coco-nut fibre" is "from the hard shell of the coco-nut," but from the outer sheath or husk enclosing the shell. Strictly "Bump Yarns" signify counts below 1s and not, as stated on page 7, "counts usually 3s or below." It is surprising to find in a modern treatise (page 14), a "Yarn Warping Table" occupying nearly a full page that could have been filled with much more useful matter. In the "Conversion Tables" (page 38), it is unfortunate that the headings of columns 2 and 3, 5 and 6, should read "per Running" and "per Sq. *Yard*," instead of "Metre," an error which is also repeated in the example and answer given. "Pirn-warping" (page 56) should have been described as "Warp Pirning"; there is no such operation as the former. It is also misleading to repeat on page 56, as to state on page 53, that "pirn winding" is "to wind yarn from hank form on to a pirn for the shuttle," when it is commonly wound from all other forms of yarn packages. Also it is wrong (page 56) to define "reaching-in" as a "small machine for selecting the threads for the drawer-in," and "warp-winding" as "to wind yarn from beam or ball warp to pirns or paper tubes for the shuttle." Speaking of artificial silk, under "Weaving of Warp" (page 93), "the timing of the shed may be a little late to ensure the shed is open when the shuttle enters" should surely read "a little early." It is also wrong to say that "any undue stretch in the warp will show lack of lustre," although it is correctly stated under "Weft Winding and Weaving" (page 94) that "tight (taut) picks will show as bright picks." A little more careful editing and the correction of the errors such as those indicated above will enhance the value of this useful little handbook. —H.N.

Distribution of Textiles. Bulletin No. 56 of the Harvard Bureau of Business Research (Cambridge, Massachusetts, 1926. 196 pp. $3.50).

This study of the American textile industries is the work of a group of investigators connected with the Harvard Bureau of Business Research, but the survey was undertaken "at the request of men engaged in the textile industry and the funds for carrying it on were provided by an anonymous gift." Manufacturers and traders of all kinds in the textile industry gave generous help in the planning of the survey and the drafting of the schedules. The response to the inquiries of the field workers was very gratifying, and a large amount of confidential information was placed at the disposal of the Bureau. All this reads like a fairy tale to those who have attempted to carry out similar pieces of work in this country, where there is still such widespread apathy towards statistical studies of the textile trades. It is heavy uphill work to get our main body of textile industrialists even mildly interested in the collection of statistics. But the reading of this book leaves no doubt in one's mind about the value of such studies. The American textile producers have ample reward for their initiative in the precise information conveyed in this volume. We congratulate them and hope their example will speedily be followed in England. The study is confined to the distribution of woven fabrics, and shows the relative volume of textile goods flowing through the several channels of distribution. After a brief explanation of the reason for using the data provided by actual invoices of goods despatched through various channels, a detailed analysis is given of the results of inquiries relating to woollen and worsted fabrics, rugs and carpets, silk cloth and ribbons, and cotton fabrics. These results relate chiefly to the proportions in which goods pass from the manufacturer to wholesale piece merchants, the wholesale clothier or maker-up of garments, and the retail traders. In the

course of the analysis, much light is shed on the economic problems of the American textile trades. In common with this country, American producers are feeling the change in the social habits of consumers. The "style factor" is shown to be the predominant cause of the hand-to-mouth trading which has displaced the steady trading for a season in goods that could be produced in bulk in advance. The suspicion that American demand for both cotton and wool fabrics is tending to move on to cheaper ranges of materials is confirmed. The reduction in the size of orders placed with manufacturers which is becoming so marked a feature of our trade in this country is another reflection of the vagaries of fashion. Recriminations between the several groups in the industry are as frequent in America as they are here when the problem of adjusting price levels and cutting losses is under discussion. The retail trade with them, as with us, is apparently the main stumbling block to the rapid adjustments that are needed to maintain the flow of demand. These and many other points are raised. The chief inference drawn by the investigators is that manufacturing and marketing must be adjusted to the new tendencies in demand. Changes of style should be viewed as "a positive, sales-stimulating influence." Better marketing means better team work than we have seen in the past. Americans are telling of organising more co-operative selling and cutting out the waste entailed by elaborate competitive sampling and production over an ever increasing range of cloths and styles. We are also talking of the same thing in this country. But where we are compelled to walk and talk in the dark for want of accurate statistical information, our American competitors are able to walk and talk in the light shed upon their problems by such valuable studies as these produced by the Harvard Bureau.

—A.N.S.

The Testing of Yarns and Fabrics. By H. P. Curtis. London: Sir Isaac Pitman & Sons, Ltd. (pp. 161 and Index. 5s. net).

In an introduction to his work, the author states that it has been written specifically for those engaged in the manufacture, merchanting, retail sale, and use of textiles. With this object in view he has endeavoured to survey the field of textile testing, giving a general idea of the raw materials consumed in the industry, of the simpler chemical means used for their identification, and of the mechanical methods employed in determining quantitatively their physical properties. He has, however, overlooked the main consideration in the preparation of an elementary text book, namely, that accuracy is essential. One is astonished to hear, for example, that the central portion of the silk fibre is composed of *fibrion* (p. 25), that if wool be exposed to the atmosphere in warm, dry weather, it contains from 30 to 50% of moisture (p. 31), that weak sulphuric acid stains cotton blue (p. 33), and that moisture tests are usually carried out at 55° C. (p. 65). It is inaccurate, also, to say that Primuline may be diazotised with sodium *nitrate* and hydrochloric acid (p. 95), that "common yellow" is otherwise known as *chrysophimne* (p. 95), and that mercerised cotton (p. 101) and starch (p. 102) gives a blue colouration with potassium iodide solution. The author apparently believes that chloroform is a highly inflammable substance, and accordingly gives directions concerning its use (p. 104). It would appear unnecessary to recommend "gramme weights and metric weights" as advisable for use with the balance (p. 45), and he has his own ideas concerning the most convenient method of using a desiccator (p. 90). On account of its mistakes and mis-statements, he should revise this book as soon as is conveniently possible.

—F.L.B.

GENERAL ITEMS AND REPORTS

Manchester Textile Exhibition

This exhibition, held at Belle Vue, was an important item in the Civic Week programme and proved well worth a visit. Over a hundred firms took space and were representative of the following sections of the industry—Engineering, spinning, manufacturing, and merchanting. In addition, stands were occupied by newspapers and textile journals, and there were also displays of work done by the students of various technical colleges and schools. As is usual in present-day textile exhibitions, artificial silk played a very important part, and many varied and beautiful exhibits were to be seen, both in piece goods and made-up garments. A model of the Port of Manchester formed the exhibit of the Manchester Ship Canal Company and attracted a great deal of attention. In connection with the exhibition, the British Model House, Ltd., held a mannequin parade in a specially-constructed theatre three times each day, and very full houses testified to the popularity of the feature. These parades were under the management of Mr. Arthur White, to whom every credit should be given for assembling a very attractive array of frocks and coats, and for the manner in which they were shown. A special feature of the parade was a display of period dresses—eighteen in all—dating from the eleventh to the nineteenth century, which gave a very clear idea of the evolution of fashion. Although some of the exhibitors had rather marred the effect of their stands by overcrowding, thus giving the impression of "heaviness," the exhibition as a whole was extremely good and, being of a general textile character, was of interest to all visitors. The organisers of the exhibition, *The Manchester Guardian Commercial*, are to be congratulated on a contribution well worthy of Manchester's Civic Week.

Textile Exhibition at Leicester

Since the last exhibition organised by the *Textile Recorder* at Leicester in 1923, there seem to have been few innovations in knitting machinery. Some minor novel textile accessories and small improvements to standard types of machinery, however, provided a note of freshness at this year's exhibition at Leicester, 8th to 23rd October. Perhaps as interesting exhibit as any was a fast-running ribbon loom made by a foreign firm, which was weaving unsized artificial silk yarns, with no extra twist, at a rate of 700 picks per minute. A simple device enabled the operator to change or vary the number of picks per minute, with celerity, accuracy, and ease. Worth mentioning also was an improved testing machine for stretch and breaking strength of artificial silk yarns, the findings being recorded automatically on a graph. A most ingenious jacquard embroidery machine was displayed on one of the stands. Using the normal selection device actuated by a continuous card, and applying it to control the movement beneath the embroidery needle of a fabric-holding frame, this machine, which, apart from the jacquard mechanism, resembles the ordinary sewing machine, was perhaps the most interesting novelty in the exhibition. As was natural at an exhibition in the Leicester district, a fair proportion of the floor space was given over to knitting machinery, most of which, apart from the more general use of jacquards in both flat and circular machines, was much the same as that shown three years ago. In the fabrics section there were several very beautiful and interesting collections of artificial silk yarns and fabrics, and it was noteworthy that practically all the English producers, together with agents of some important Continental producers, were represented. When it is remembered that at the last Leicester Exhibition only one British firm of artificial silk producers had an exhibit, whereas to-day no fewer than five have taken space, an interesting sidelight is thrown on the development of the artificial silk industry. Many firms of spinners exhibited mixture yarns of cotton or wool and artificial silk, and there were not wanting examples of fabrics of cotton and acetate silk, wool and viscose, which had been cross-dyed—a practice which may have been somewhat overdone. One important inference might be drawn from a visit to the exhibition as to tendency with regard to the character aimed at in production of both yarns and fabrics containing artificial silk. There seems to be a definite movement away from lustre emphasis and distinct effort in the direction of approximation to natural silk from the point of view of lustre. Mixture yarns, at any rate, were much more in evidence than previously, and this may have been due to the movement already indicated.

Collaboration and Distribution of Wool Textiles

A meeting of the Bradford Textile Society was held at the Midland Hotel, Bradford, on Monday, 11th October, when Mr. Arthur Hitt, the President, delivered the lecture. Mr. W. A. Elliott presided. Mr. Hitt said that they had had men in Yorkshire who, by great initiative, highly-trained technical skill, and all-round efficiency, had made their names familiar all over the world, but they had concentrated almost entirely on the side of production. Twenty years ago it might have been said that if we made the right cloths at the right price they would sell themselves. That did not obtain to-day. Our greatest problem was not so much production as marketing. He suggested that what was wanted was collaboration with retail distributors and the buying public; some form of co-operation in selling; and collective use of publicity. He suggested that the trade collectively should form an Advisory Council, in which the buying public and the wholesale and retail distributors should join with the manufacturers, in order to get a forecast with regard to probable fashions, make of cloth, colour, &c., some months prior to the season starting. That would eliminate the waste of experimental patterns and accumulated bad stocks which were costly to manufacturers, merchants, and dyers. The public, because of it, would have better value, and production and demand would be kept in tune. There were probably two hundred mills in Bradford trying to make the same or similar cloths, with two hundred selling organisations. This involved enormous waste in experimental patterns, giving the dyers many thousands of patterns to dye every year, the majority of which were never followed by bulk business. This waste would never help us to capture markets, and such methods did not mean economy in either production or distribution. How much better if these mills were formed into groups, allocating one cloth to one mill, and by something like mass production lower the costs and economise distribution. Bradford cloths were now filtering through to the public unrecognised by that public. Neither merchants nor retail distributors were functioning in the sense of linking up the British maker of the cloth with those who wore it. Nothing had been more revolutionary during the last twenty years than the increased influence of publicity. Its demands alone must have the tendency to drive firms into groups, as no concern could adequately finance it in addition to other distributing costs. Applying publicity to the Bradford trade involved the fundamental recognition of the cloths by the public when it saw them. A selvage controlled by the Bradford Chamber of Commerce was one of the suggestions made. Failing this, cloths could be offered under registered names, but whether selvage or name, propaganda was essential. The future outlook seemed to depend on our recognising the public willingness to buy Bradford goods; the merit of the goods; the pressing need to secure greater prosperity for the industry. All these were contributing factors to collaboration, markets, and distribution.

Mr. W. H. Suddards said collaboration must have a much wider scope than the mere object of raising prices. Unless it was going to improve methods of production and develop greater initiative and greater economy in production, it would be useless. The idea behind collaboration must not be that it would be more profitable to the individual Bradford manufacturer; it must be of benefit to the nation as a whole.

Mr. Wm. Wright said that assuming they could manufacture the right type of cloth for certain markets and were willing to give credit, there were still difficulties which the exporter had to meet. The first of these was the price factor. In that respect they would be the gainers when countries with depreciated currencies were brought on to a gold standard. There was also the difficulty of the reduced buying capacity of the foreigner. A good deal could be done to stimulate that buying capacity by indirect methods. For instance, China, with 400 million people, bought only twice as much as the Argentine, with 10 million people. If a vast country like China could have its purchasing power developed by building railways and so forth, she would become a very powerful customer.

Mr. A. M. Chapman said that what Bradford wanted was a big volume of trade on standard cloths. The novelty trade would not keep them employed.

A vote of thanks was accorded to Mr. Hitt, on the motion of Mr. John Mason, seconded by Mr. J. Lester.

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PROCEEDINGS

ANNUAL CONFERENCE OF THE TEXTILE INSTITUTE

At Buxton (Derbyshire), 20th, 21st, and 22nd October 1926

Postponed from Whit-week last, the Annual Conference of the Institute took place at Buxton on the above-named dates. Except that postponement probably accounted for the fact that the number of members in attendance was not quite so large as usual, the attendance under prevailing conditions was quite satisfactory, and the fixture was most successful. The accommodation and facilities available at Buxton for conference purposes are excellent, and the visit to this Derbyshire health resort was thoroughly enjoyed. The programme opened with an evening reception at the Town Hall by invitation of the Mayor and Mayoress of Buxton (Alderman and Mrs. T. H. Cooper), and about 150 guests were present. At a suitable interval in the programme of vocal and instrumental music, the Mayor expressed a hearty welcome to the visitors, and regretted that it had been necessary to postpone the conference from Whitsuntide. At that time they little thought that as late as October the country would still be in the throes of the unfortunate coal industry dispute. He trusted that the Institute's visit to Buxton would prove both useful and enjoyable, and that visitors there for the first time would find sufficient inducement to return on some future occasion.

The President of the Institute (Mr. William Howarth, J.P.), on behalf of the visiting members and friends, expressed warmest thanks to the Mayor and Mayoress for the entertainment and hospitality afforded and for the generous manner in which the municipal authorities had helped in regard to the arrangements for the conference. With the Mayor, he regretted the cause of the postponement of the fixture. So far as the textile industry was concerned, the Institute was a movement in the direction of higher efficiency, and the bringing together of representatives of various branches of the industry at that conference was calculated to strengthen the Institute and to promote good feeling between all sections.

The conference met on the Thursday morning (21st October) in the Town Hall, when the President of the Institute occupied the chair, and was supported by Messrs. John Crompton, W. Frost, T. Fletcher Robinson, and E. T. Holdsworth. Introducing Sir William Bragg, the contributor of the annual Mather Lecture, the President said—This lecture was inaugurated in 1919 not only in recognition and appreciation of the splendid services and generosity of the late Sir William Mather, in the capacity of President, but in order to advance the standard of Institute lectures. Sir William Bragg is a Cumberland man whose name is known to men of science in all parts of the world for the wonderful way in which, with his son, who is the Langworthy Professor of Physics at Manchester University, he has used X-rays to explore the structure of crystalline bodies. The discoveries of father and son justly merited the award of a Nobel prize in 1915.

During the war they applied themselves to the important problem of sound ranging, and so valuable were their services that we may rightly say that few men more thoroughly deserved the order of Knighthood which His Majesty the King was pleased to confer on our lecturer. Sir William is now Director of the Davy-Faraday Research Laboratory, and Fullerian Professor of Physics at the Royal Institution. In these honourable appointments, he is walking worthily in the steps of a succession of brilliant men, and we are confident that history will accord him a place equal to that of Davy or of Faraday. Like Faraday, Sir William has the supreme gift of being able to make plain the deep things of science. His Christmas lectures to juvenile audiences—"Concerning the Nature of Things" and "Old Trades and Modern Science"—and his talks from our broadcasting stations have been ample proof of this skill, and we men of the spindle and the loom are shortly to be given another. In the past year or two, Sir William has applied his analytical methods with the X-rays to the study of organic chemical substances, and had thus come into the field where he makes direct contact with the textile industries. Very far-reaching results can be expected to follow investigations into the intimate structure of textile fibres, and I am sure we shall all profit by the review of the progress already made in this field which Sir William is now about to give us.

THE MATHER LECTURE

THE FINE STRUCTURE OF ANIMAL AND VEGETABLE SUBSTANCES AS REVEALED BY X-RAYS

By Sir William H. Bragg, K.B.E., D.Sc., F.R.S

In the year 1912 Laue suggested, and Friedrich and Knipping carried out, an experiment of fundamental importance. It proved that X-rays could, under the right conditions, be diffracted in the same manner as light waves. The diffraction of light is a fact of common observation, manifested in the haloes that surround luminous objects viewed through a cloud of small particles, as when the moon is seen through a misty atmosphere, or again, in the colours of insects, beetles, and birds to which Nature gives some permanency by forming them, not from pigments or dyes, but from the diffracting effects of an ordered array of fine points or fibres, or scales. While the diffraction of light is to be observed at all times and in all places, the diffraction of X-rays requires unfamiliar mechanism for its production and for its detection, and has escaped observation until now. Our past ignorance is easily understood. The rays themselves consist of waves ten thousand times shorter than light waves; though their nature is absolutely the same, and if light consists of waves travelling through an ether which fills all space, so also must X-rays consist of waves travelling in the same medium. The only difference is in the dimensions of the waves. But that difference removes the rays far from the range which our eyes are formed to perceive. The range of vision by eye is very narrow; the wave must be distinctly less than the ten-millionth part of a centimetre if it is to make any impression on the eye, and the shortest wave that can be seen—that which gives the sensation of violet—is about half the length of the longest, which is red. Within this range are all the waves of visible light; with these waves Nature has made it possible for all conscious beings to be aware of their surroundings—to have eyes and to see.

Outside this range we have no direct means of detecting ether waves except that we become conscious of somewhat longer waves by the sensation of warmth which our skin can feel. It is no wonder, therefore, that only in recent times have we been able to extend our natural powers and, by means which we have not received as a natural endowment but have discovered for ourselves, have

learnt to produce and detect and make use of waves outside the visible range. Long waves, far outside that range, are used now in wireless telephony, thanks to the discovery of the valve. The extremely short waves which we call X-rays lie on the other side, and for some thirty years, ever since Röntgen's original discovery, we have known how to produce them, how to detect them, and how to make use, chiefly for medical or surgical purposes or in the examination of materials, of their powers of penetration which differ so strangely from those of light. Until Laue's experiment we were not able to assert without question that they were waves at all; we had them at our command without being aware of their nature. The essential importance of Laue's experiment consists in the first place of the resolution of this doubt. But it goes far beyond this point. The very method by which the uncertainty has been removed has opened up wide fields of usefulness of which the existence had never been suspected. It is my object to-day to explain this matter very briefly, and in doing so to speak especially of those portions of the new field of inquiry which may be of interest to this Conference

The diffraction of light waves serves as a useful analogy if we wish to appreciate the principle of the new methods. The essential point is that in any case of diffraction it is always possible to draw inferences from the observed result as to the nature of the cause. If, for example, we observe the width of the moon halo we can calculate the average size of the particles in the air which produced it. If we take proper note of the colour of a butterfly's wing we can determine the spacing of the scales. In the more complicated case of the diffraction effects seen in the microscope, we may infer the form of the objects which caused them, although they are so minute that their outline cannot be observed directly—and this is the basis of a well-known and very important use of the microscope.

Now in the case of the X-rays, the diffraction effects are produced by the ordered arrangement of the atoms in a crystal, and the study of those effects tells us about the arrangement. The experiment is simple enough in conception, though the technique may sometimes be difficult. The interpretation of the results of the experiment is sometimes easy, sometimes not. When, for instance, we pass a fine pencil of X-rays from an ordinary X-ray tube through a thin plate of rocksalt, and receive the transmitted rays on a photographic plate, we find, after development of the plate, not only one spot in the centre of it where the original pencil has fallen, but also a very large number of weaker spots ranged symmetrically round the first. These extra images are due to the diffracted rays. Their position on the plate and their relative intensities furnish a mass of accurate numerical results from which it is possible to determine the structure of the crystal and the relative positions of the atoms of which it is composed. In the case of rocksalt, the problem is simple and the structure of rocksalt was one of the first to be unravelled. Since that time many more complicated solutions have been effected, but great numbers of crystal structures are yet awaiting their conquerors.

There is, in fact, a new game to play. With a little patience it is possible to acquire the experimental skill which is necessary for the production of the X-ray photograph of a crystal. It is not so difficult to build up the apparatus, to set it going with some small crystal or mass of powdered crystal in its place, to watch it for the necessary time (an hour or part of an hour, or several hours, as it may be), and then to develop the plate and observe the pattern of spots; and there are hundreds of thousands of known crystals which no one has yet treated in this way. But it is a very different thing to interpret the observed results. The position of each spot on the plate can be measured with great accuracy; its intensity can be estimated within certain limits. In fact, a mass of informing details can be obtained, of which the accuracy is no illusion because the measurements bear the most exacting repetition. We do not, however, know yet how to use it all.

Certain results can be immediately obtained which show an almost unexpected simplicity in many of the natural structures. We can find at once the size of the unit of the pattern; in a large number of cases it contains two, three, four, or more of the molecules which the chemist has taught us to recognise. This is the first and generally the easiest step in the interpretation. It always seems to me that there is something of extraordinary interest in this determination. When Nature forms the solid body she takes a certain number of the molecules with which our examination of substances in the liquid or gaseous state has made us familiar, and builds them together into the unit of pattern. We can always find out how many of these molecules she has taken for the purpose—generally quite a small number. That is one of the easy steps in the analysis. Moreover, she uses them all in the same way in a very large number of instances, though we have found some exceptions. This point is not, it may be, readily appreciated without some consideration. In the packing of sardines, for example, half the fish lie one way, the other half lie heads to tails with the first; the fish are therefore divided into two sorts so far as arrangement goes, and we must take one of each kind if we are to represent the conditions completely; in other words, the unit of pattern contains two fish. But there is no difference in the relations of any fish to its neighbours, no matter from which kind it is taken. It would be easy to imagine a more complicated packing of the fish; we might, for example, have alternate layers at right angles, thus having four kinds or orientations, and the representative unit of pattern must contain four fish. And again, we might have some layers with all the backs of the fish pointing one way, and an equal number of balancing layers in which the backs of the fish pointed the other way, and in this way the unit of pattern might be still more complicated. And if we might imagine each fish to be differently marked on its two sides, we might increase our complications yet further by requiring or by not requiring that there should be equal numbers of the two kinds. Just so, Nature arranges her molecules in her crystals, and it is a striking and simplifying fact that it usually is the molecule which she treats in this way—not some entirely fresh arrangement, such as the taking of the atoms of two molecules and putting them together in a new way to form a molecule which is not exactly two old molecules combined, as if two sardines had been remodelled into one pilchard. I use the word "usually" because we can find quite a number of cases in which remodelling has taken place, for example, in α-naphthylamine or in fumaric acid.

All this variety of arrangement in the crystal can be detected by the X-ray methods; we can find not only how many molecules are used in forming the unit of pattern, and what is the distance between a molecule in any one unit and a similar molecule in any other unit, but also we can find out what we may call the system of packing. This is an important step towards the full knowledge of the structure of the crystal.

But it is very far from being the whole story. We have still to find the position of every atom in the molecule, not only in relation to the other atoms in the same molecule, but to the other atoms in the other molecules in the unit of pattern. Here is the greatest difficulty of the problem. It is not that we have not got enough experimental facts: we have an ample sufficiency. What we lack is skill in interpreting them. But this latter grows every day. When the first few simple crystal structures were resolved some twelve years ago, it seemed that the vast bulk of the known crystals would be far out of our reach. And now fresh solutions appear continually, and complicated structures have yielded to the incessant labour of quite an army of researchers in various parts of the world.

But, we may ask, of what nature is this new information? Chemistry has taught us the composition of the various molecules and their probabilities of mutual action and rearrangement if they meet each other; we have learnt to measure the emission and absorption of heat when such reactions occur; and so we have learnt to understand and to foretell the consequences of these meetings. What does this new knowledge tell us?

The answer is that we are informed of the structure of solid bodies. Now the properties of solids are of the greatest interest and importance; ourselves and the things that we handle and deal with every day are largely solid. The properties of solids—rigidity, tensile strength, extensibility, heat capacity, optical powers, and very many others—are properties of the molecules when bound together, and are to be associated with this binding. There is no arrangement in the molecules of a gas or a liquid; the form of the molecule is of importance, of course, for the whole range of stereometric chemistry is witness to the fact. But the arrangement of the molecules in the crystal is a new factor in the situation, giving birth to the well-known properties of the solid, allowing the molecules to exert their mutual forces in a new way with entirely new results. All the properties of solids must eventually be explained in terms of the arrangements of the atoms and molecules which they contain. Arrangement is the especial feature of the solid, and those properties which are characteristic of the solid are due to it. It might be argued that there may be amorphous bodies which have no arrangement and yet are solid. But the evidence is rather on the negative side. Great numbers of substances are found to exhibit crystalline structure of some sort, when carefully examined, though there was no evidence of the fact until the X-rays revealed it. They may and often do consist of aggregates of minute crystals entirely beyond the power of the microscope to detect, but plain to the X-rays. If the crystals are very small, consisting of only a few molecules, even the X-rays, in the present state of the technique, may fail; but the boundary between the arranged and the completely disarranged is very hazy and tends to disappear. The fact is that arrangement is, so to speak, the natural state to which all things tend, though there may be hindrances of indefinite duration. Chemistry has dealt with the properties of fluids and liquids—not with those characteristics of solids. In fact, the methods of chemical analysis generally begin by destroying the ties that form the solid, and in so doing removing the very essence of the solid state. Only of recent years has it become necessary to take into account the nature and the influence of the surfaces of solids where the arrangement characteristic of the internal structure comes to the surface—in the literal sense. It may well be and doubtless is the case that the surface disposition of the atoms is modified by their partial freedom from the restraints which within the substance surround each atom, or by the adhesion or absorption of strange atoms. In this way the orientation or even the forms of the molecules may be modified, and their activities may be cloaked more or less; as we may say, their catalytic properties may be altered. These surface actions have acquired enormous interest in recent times, as we all know. The more we learn of them, the more we are impressed by the part they play in the processes of the world. Yet, after all, the bodies that act on one another, and in so doing continue the world history, are many of them solids and can act at their surfaces only. The point is that the disposition and orientation of the molecule on the surface is of vast importance, and we shall not understand this vital matter until we first grasp the simpler thing, viz. the internal arrangement in all its regularity. We shall then be in a better position to appreciate the more complicated state into which the simpler falls when outside agencies work upon it at the body surface.

It is here that chemistry is, so to speak, feeling its way into the solid body. The liquids and gases which have necessarily been the main subjects of inquiry hitherto have come up against the solid and felt its influence; and now the X-rays have come to tell us what is behind this surface, in regions where new rules are in force and govern the manifestation of new properties, those namely which are characteristic of the solid. The vast range of solid substances now lies open to a far keener examination than it has ever received before, and already some progress has been made.

The simplest of all bodies is the single crystal. That is somewhat curious because at one time we used to think of the crystal as the complex, in contrast

with the isotropic solid which had exactly the same properties in all directions. But the properties of such a solid are only to be secured by an averaging process—by piling together a number of minute crystals having all manner of arrangements. Of course, as has been already said, we can conceive of an entirely disordered arrangement of molecules, but as a matter of fact such an arrangement has not been actually proved to exist, and it may well be that there is some completed arrangement even in what we think to be a quite amorphous body.

The perfect crystal is very rare. Perhaps the diamond alone deserves the title of all the crystals we know, but it is not likely that one substance should be so completely differentiated from all others. Iceland spar is somewhat inferior to the diamond, in that the X-rays show it to be a mass of smaller crystals slightly varying in orientation. Rock-salt is much inferior; the disarrangement of the various small crystals of which it is composed is very obvious under the X-rays; and other bodies range themselves in various degrees of perfection, until we come to those in which the X-rays can barely detect the existence of any arrangement at all. It is common to find substances in which minute crystals are distributed in some containing medium; cotton and woollen fibres are examples of this condition, and are naturally to be chosen as illustrations on the present occasion. Sometimes the degree of crystallisation varies with circumstances. A most remarkable example is to be found in the case of india-rubber, which has lately been carefully examined by Katz and others. It has been shown that in its unstretched state there is no arrangement which the X-rays can detect, in the present state of the technique, but under tension, crystals form rapidly until, when the rubber is completely stretched, a condition which we all know from experiment, a very large, perhaps complete, conversion into crystals has taken place. With relaxation the crystalline arrangement disappears again.

It is a most remarkable fact that the minute crystals which are often found to be distributed through the body of a material show some regularity of arrangement. When it exists, we naturally look for its origin in some predisposing cause, and the nature of the cause is suggested by the nature of the regularity. Such a state is often found, for example, in a metal, and proves to be the result of some mechanical treatment. The crystals do not point every way; some one direction is found to be related more or less closely to a direction of rolling or drawing. In the same way the "crystallites" of animal and vegetable substances show some relation to the direction of growth as well as to the direction of any mechanical strain.

Now if we remember that all the physical properties of a fibre depend on the arrangement of its constituent atoms and molecules, and that the incipient crystallisations or crystallites are features of this arrangement, it must appear that the whole matter is worthy of serious study. What will flow from it no one can foretell. We can only argue by analogy or from extrapolation. Chemistry has studied the individual molecule and the reaction of molecules when they move, separate and free, in the liquid or gaseous state. The results are clear. What shall we perceive when we can see clearly the details of the arrangements that make the solid? We cannot prophesy; we can only expect.

It becomes, I think, an obvious task that we should examine by the new methods all the fibres and other substances on which our textile industries are founded; that we should see what such an examination has to tell us of the internal structure of the fibre. We should find out whether the X-rays can follow the changes that fibres usually experience in manufacture or under any treatment; we should want to know not only all the complicated and very important actions and dispositions in the interior, but also the nature and properties of the surface since these properties are so important in relation to such processes as, for example, the absorption of a dye.

We have not, I am bound to say, done much in this country. As you may know, the methods of X-ray analysis were first devised and used by ourselves,

and work in this direction is steadily proceeding in England. But the special application of the new methods to the textile problem has been conducted abroad, mainly in Germany, especially at the Kaiser Wilhelm Institut für Faserstoffchemie. The results obtained in these studies are already proving to be instructive and promising in the highest degree. They may not be immediately applicable to the solution of technical problems, but their future value is none the less likely; the whole matter is only in its preliminary stages. We have to think of the future and must put up with the delays of growth. What has been learnt must already be considered as indicating the promise of the method, as showing that new powers are in our possession. We know well from past experience that when a new departure of this kind is made, the point which is finally reached is rarely to be imagined at the outset; that which we first imagine we are going to do with some new method often comes to nothing. We really cannot see far enough ahead. We are led on by the conviction that new light on what we are doing will always enable us in the long run to do better. Light, and more light, is what we should always ask for, not some definite technical achievement. Give us more light on what we do, and we can depend on our own perception and ingenuity to make the best use of it. It is in this spirit that we should consider what has been done and is being done in the application of the new methods to the study of textile fibres.

The earliest application of the X-ray methods to the study of fibres showed at once that there was something to be seen—that, in fact, there was something crystalline about them. Nature had been successful in arranging some parts of the fibre in a regular fashion. As the technique of the analysis has improved the results have become more and more definite, and it is now possible to obtain diffraction figures which are comparable in clearness of definition with those obtained from structures that are fully and obviously crystalline.

From these figures we learn a number of things. In the first place the fibre contains a multitude of fine crystals which not only possess in each case that regularity of internal arrangement which is characteristic of the crystal, but also possess some regularity of mutual arrangement. There is a certain line in each crystal which is directed more or less along the axis of the fibre. In some way, not understood, the growth of the fibre not only forms these crystals, but orients them in regard to this one direction. Otherwise their orientation is haphazard; they may take up any position about the unique direction. We know this from a peculiarity in the arrangement of the diffraction pattern which is easy to observe but too complicated to explain in the short time at our disposal. It can be illustrated by the accompanying figures. The first shows the diffraction pattern of ramie fibre, obtained by passing a fine pencil of X-rays through a bundle of parallel fibres, so that the pencil subsequently falls perpendicularly on a photographic plate. The pencil would make a very strong impression on the plate at the point where it strikes if it were not that a screen has been placed so as to intercept it. The effect would be so violent as to spoil the central parts of the plate for the reception of other and feebler impressions. The diffraction pattern consists of an arrangement of spots which is symmetrical both with regard to the vertical and the horizontal. The vertical line is parallel to the axis of the fibres.

The next figure is the diffraction pattern of a single crystal of sugar, but in this case the crystal has been steadily rotated during the exposure about an axis perpendicular to the X-rays and parallel to the plate. Here again the general features are the same, but the spots of the pattern have their own characteristic positions and intensities.

In the case of the single crystal of sugar no pattern is obtained without the rotation. If we could watch the spots forming on the plate, instead of having to wait for the action of the photographic developer, we should see the spots dropping into their places one by one as the crystal revolved. They may be considered to be due to reflection of the X-rays by various planes in the crystal.

It is a fundamental principle that the rays are only reflected by any plane within the crystal when there is the correct angular relation between the rays and the plane, a relation characteristic of that plane. Otherwise there is no reflection at all. As the crystal is revolved one plane after another comes into its correct position. If the crystal had not been revolved, one or two spots might have been formed accidentally on the plate, but there would be no complete pattern.

It was not necessary to revolve the ramie fibres, because all possible positions of the crystals were already represented by various members of the bundle. It is for this reason that the general characteristics of the two illustrations are the same. It is in this way that we learn that in the bundle of fibres there are crystals which all have one direction in common, but otherwise are in complete disarray.

It is certainly not surprising that in this way also we find a complexity in the structure of the fibres, because the fact has already been surmised for other reasons. The physical behaviour, and especially the curious laws of extension of the fibres, have led investigators* to suppose that there are two phases at least in the fibre—one possessing perfect elasticity and the other the viscosity of a liquid.

The next point for consideration is the size of the unit pattern. This can be deduced from measurements of the positions of the spots on the diffraction pattern. I shall not attempt to explain how this is done because it would take far too much time. I shall only state the results that Herzog gives (*The Journal of Physical Chemistry*, April 1926, p. 457) as the result of many measurements. The unit pattern is contained in a right-angled cell, the sides of which measure 8·60, 7·78, and 10·22 Angstrom units† respectively. If we calculate the volume of this cell and multiply it by the specific gravity of cellulose, 1·52, we find that the weight of the cell content is 1040×10^{-24} gr. Now the actual weight of the cellulose molecule is 162 times the weight of the hydrogen atom and can be readily calculated to be 270×10^{-24} gr. The weight of the cell is therefore very nearly four times the weight of the molecule, and we assume that there are actually four molecules in the cell, for the number must be an integer and the experimental errors may well account for the small failure to reach an integral value in the experiments and the calculations. This means that the crystalline structure is really simple, in that it is formed by the mere repetition of a fundamental unit of pattern containing only four cellulose molecules. A very large number of other substances have four molecules to the cell.

This same summary due to Herzog contains other conclusions of great interest, but I will only mention one or two. It is shown, for example, that in cellulose nitrate and in cellulose acetate the structure is very nearly the same as in cellulose itself; the unit cell has the same form and nearly the same dimensions as that of cellulose, from which it is deduced that in the conversion into the nitrate or the acetate the reaction is topochemical. The relative positions of the four kinds of molecules, and the way in which they lie up against one another so as to satisfy their complicated attractions, are little modified by the chemical change in the constitution of the molecules. It would be easy to understand that the change in configuration and nature would be so great that an entirely new pattern would be formed, having no relation to the old. But it is not so, and there must be a meaning in the fact which we cannot at present grasp entirely because we are ignorant on so many other points.

So also Herzog states, as further results of the X-ray investigations, that cellulose fibres obtained by the denitration of a cellulose nitrate, and from the hydrolysis of a cellulose acetate (both of them being prepared from untreated cellulose), give the diagram of the latter. On the other hand, cellulose regenerated from esters prepared from a mercerised cotton gives the diagram of cellulose hydrate.

*For example, Shorter. Transactions of the Faraday Society, 1924, **20**.

†The Angstrom unit is 10^{-8} cm.

One further deduction from these measurements deserves especial mention because it illustrates another of the powers of the new methods. Diffraction effects have always this property, that the greater the quantity and the higher the quality of the arrangements to which they are due, the more perfect is their precision. The diffraction grating used on the spectrometer is ruled with many thousands of parallel lines. The extraordinary sharpness of the line in the spectrum is due in the first place to the regularity and uniformity of the ruling. So also the sharpness and brilliancy of the halo that is to be seen round a bright point viewed through a misty atmosphere, or as in Young's Eriometer through a mass of fibres, depend partly on the number of particles or fibres, partly on the uniformity of their size.

The X-rays show the analogous effect. The spots on the photographs such as those illustrated, and the lines in some convenient forms of the diffraction effect are usually very sharp because the regularity in the crystal to which the effect is due usually extends over millions of units of the pattern. If, however, the number of units falls into the thousands or hundreds, the sharpness begins to fail; and it has even been shown by Scherrer and others that it is possible to calculate the average size of the crystallites in the fibre. Herzog thus finds that the average sizes of the crystallites of cellulose nitrate and of cellulose are about the same, each containing one or two thousand molecules; the size of particles in colloidal solutions of cellulose nitrate has the same value.

I have chosen this instance of the application of the new methods to the study of natural substances because it is related to those materials in which the members of the Conference are particularly interested.

But the methods have many other applications. In fact, so it seems to me, its universality is one of its greatest charms. All arts and sciences and industries employ solid substances, and their operations are dependent on the physical properties of solids. These properties depend, in their turn, upon the arrangement of the atoms and molecules, an arrangement which in the hands of Nature becomes surprisingly regular. Now the X-rays enable us to investigate all the details of the regularity as nothing else has hitherto been able to do. Thus the method has been applied to the study of the crystalline structure of metals, where, indeed, the relation between the crystalline condition and the physical properties has long been realised, though never could it be examined so thoroughly as now. A curious and more recent example is that of rubber. It appears that unstretched rubber shows very little regularity of arrangement, but that, as it is stretched, crystallites form and, in the end comprise, it may be, the bulk of the substance. When this point has been reached the rubber no longer extends so easily as at first. When the strain is relaxed the regularity disappears. The applications to biology are as yet very few and far between, though we know now the interesting fact that regularity of arrangement occurs in growing structures and is related to the direction of growth. This development of the subject is only just beginning. Another example is to be found in the remarkable conclusions of Shearer, Muller, and others, on the solid condition of long chain compounds. When substances of this kind, for example, members of the fatty acid series are pressed or squeezed, there is a rapid development of regularity in certain directions. The molecules arrange themselves in layers in each of which the long chain molecules stand side by side more or less normal to the layer. Sideways regularities are less readily developed, and are not so obvious on the photographic plate. The tendency of the molecules to pack more quickly and regularly in some directions than in others is witness to the fact that the molecule is to be thought of as having a highly irregular but definite and persistent form. Perhaps the point might be better expressed by saying that the molecule is surrounded by a very complex field of force, which when inter-locking with the fields of its neighbours will necessitate perfect alignments. We may learn more about these fields that bind solid bodies together by observing not only the finished result as in a perfect crystal, but also the incipient steps of crystallisation

when the forces of combination sort themselves out into those that must first be satisfied and those that must wait. It is these incomplete conditions that must interest us most. A complete and perfect crystal is inactive except at its surface; it is when crystals are forming or disappearing, when they are dispersed in some other medium or phase, and in active contact over large surfaces that their influence is great on the changes which we are concerned to watch. If Nature had thrown her molecules together in the solid as haphazard as in a liquid, or a gas, this new interest would not be ours. It is because regularity is so persistently aimed at and achieved, and because it is constantly breaking down and being repaired, and again because all the properties of solid bodies, so utterly important to us, are functions of this regularity, that we push on with our X-ray analysis, which depends on this regularity and furnishes the only efficient means of investigating it.

Description of Illustrations

FIG. 1—Illustrations of the diffraction of light.
,, 2—Diagram showing method of obtaining Fig. 1.
,, 3—Laue photograph of stearic acid (Muller).
,, 4—Rotation photograph of a sugar crystal.
,, 5—Ramie fibre. Homogeneous rays. Bundle of fibres held steady. The original photograph shows some thirty or forty spots, many of which are too faint to appear in the reproduction.
,, 6—Aluminium foil rotated about an axis parallel to the direction of rolling (1 1 1). Homogeneous rays.
,, 7—Unstretched rubber (Hauser).
,, 8—Stretched rubber (Hauser).

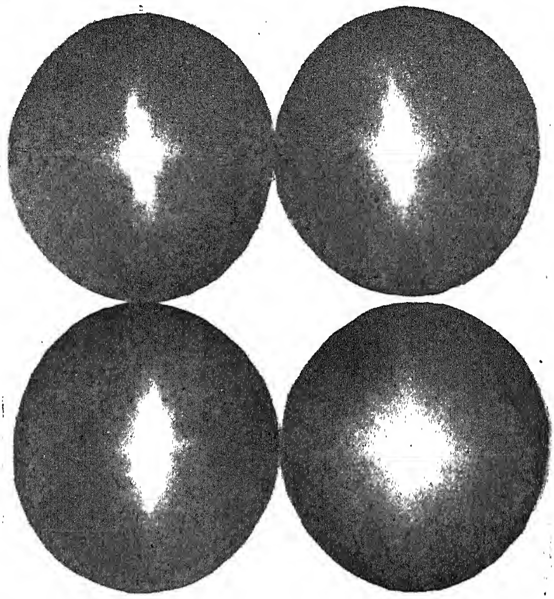
Discussion

Dr. Shorter, in proposing a vote of thanks to Sir William Bragg, stated that he had special pleasure in doing so, since it was at Sir William's instigation that he first undertook research in textiles. It was at Leeds some ten years ago that Sir William was instrumental in inaugurating a piece of work which may be regarded as the starting point in Yorkshire of that movement which had culminated in the establishment of the textile research associations. With regard to the present lecture, one realised that though research in X-rays was a difficult matter, the exposition of the results of such research to a general audience was still more difficult. Of such exposition Sir William Bragg was undoubtedly the greatest master in England and, perhaps, in the whole world.

Dr. W. H. Gibson (Belfast) seconded and said the Institute had been fortunate indeed to secure the services of Sir William Bragg, whose choice of subject for the Mather Lecture was most gratifying, because a knowledge of the fine structure of fibres was felt by all investigators to be of prime importance. It was highly probable that such knowledge would have a profound influence on the investigation of textile problems. Personally, during twenty years of engagement in industrial research work, principally upon cellulose, he had always felt himself to be in the dark to the extent that little was really known of the fine structure of cellulosic fibres. The investigations now progressing would give the scientist working on cellulose a clearer mental picture of his material. Investigators lacked adequate tools for their work. Here was a new weapon of investigation which had already proved its value, and though it might not be universally used in industrial research laboratories, even a limited use would lead to the better understanding of textile fibres with a resulting improvement in our methods of testing and appreciation of the results of those tests. The work of Herzog referred to in the lecture, which showed that the size of the crystallites of cellulose nitrate and cellulose, and the size of the particles in colloidal solution of cellulose nitrate are about the same, confirmed the results of work on the viscosities of solutions of cellulose and cellulose nitrate, and served to explain the relationship

Diffraction Patterns of Various Fabrics

JAP SILK CREPE DE CHINE



PLAIN LAWN MUSLIN

FIG. 1

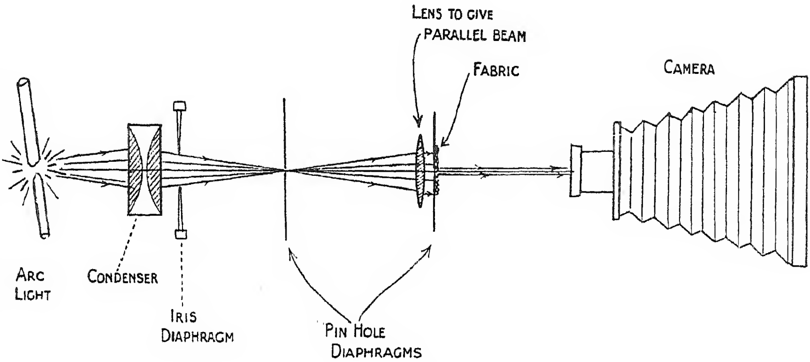


FIG. 2

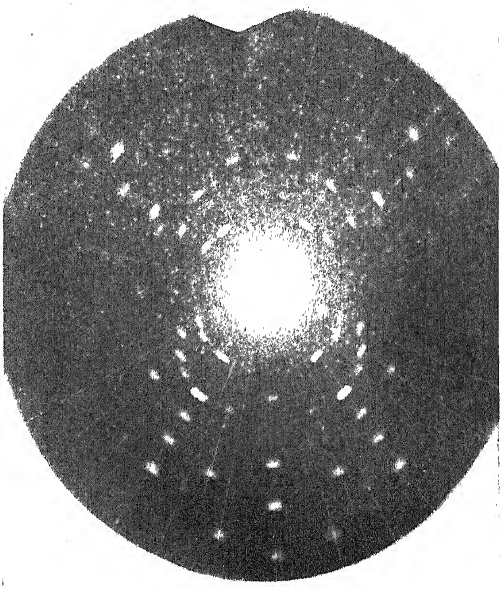


FIG. 3

LAUE PHOTOGRAPH OF A CRYSTAL OF STEARIC ACID (*Müller*).

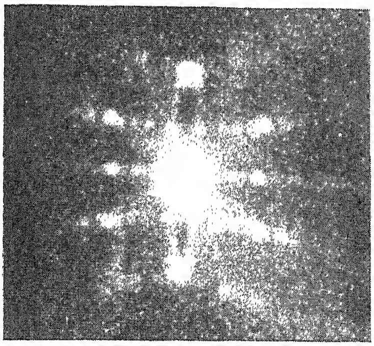


Fig. 4 Sugar Crystal

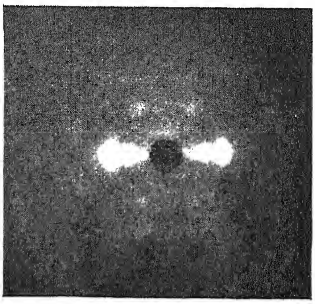


Fig. 5 Ramie Fibre

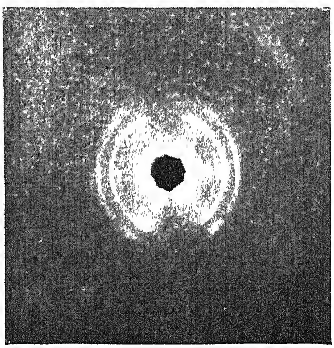


Fig. 6 Rolled Aluminium

(*The above blocks have been kindly lent by the Editor of* "Nature")

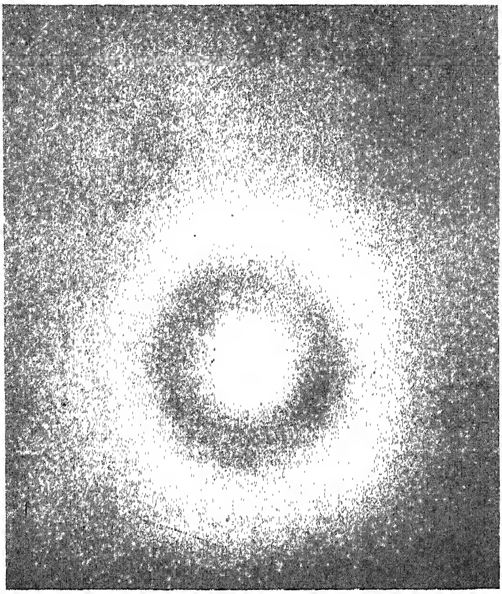


FIG. 7
UNSTRETCHED RUBBER (*Hauser*)

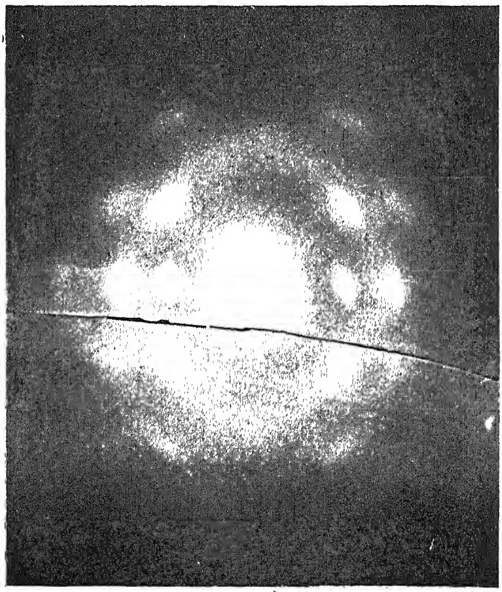


FIG. 8
STRETCHED RUBBER (*Hauser*)

between a particular sample of cellulose and its derivative. Knowledge of this relationship had already proved of industrial value in the explosives and the artificial silk industry.

The vote was heartily accorded, and in reply Sir William Bragg said he had been most anxious to make the subject attractive to the practical man because it was upon the effective co-operation of the practical man and the pure scientist that progress depended. It was an extraordinary thing to find how completely the wonderful achievements of the past centuries were due to the close and continuous reaction between the labours of industry and the thought of the seekers after knowledge. Although X-ray work started in this country, the particular application of X-rays of which he had spoken came from abroad. We must not be content to allow others to make our inquiries into the structures of things we were handling every day. We must be in the forefront of such inquiries ourselves. He was inclined to believe that this work was only the beginning of something much greater and it was expected that very shortly at the National Physical Laboratory a department would be opened to study the new use of X-rays, particularly in relation to industry. This application of X-rays marked a new departure in the scientific world.

VISIT TO WORKS AND A SOCIAL EVENING

On the Thursday afternoon a visit of inspection of the works of Messrs. Ferodo, Ltd., at Chapel-en-le-Frith, took place, the journey being by motor vehicles. The party numbered about 50 persons. At the works small groups were formed and conducted over the various departments, offices, &c. The organisation associated with these works proved extremely interesting and the extraordinary variety of the products, together with the highly specialised plant and machinery associated therewith, were a revelation to many of the visitors. After the tour of the extensive works, tea was served in a delightful new dining hall and lounge facing a bowling green and outdoor games ground connected with the works. Mr. W. A. Horrocks, on behalf of Messrs. Ferodo, Ltd., welcomed the visitors, and Mr. John Crompton, as Chairman of Council, expressed the warm thanks of the Institute members for the facilities of inspection and the hospitality accorded to them.

In the evening, members and visitors were invited to attend a social gathering in the ballroom at the Buxton Hydro Hotel, the headquarters hotel for the purpose of the Conference. A programme of dance music and contributions by vocalists was presented, and a pleasant social evening was greatly enjoyed, ending with light refreshment served at the invitation of the President (Mr. W. Howarth).

CONFERENCE PROCEEDINGS ON FRIDAY, 22nd OCTOBER

The Conference resumed its sessions in the Town Hall on Friday morning, when the President again presided. He called upon Mr. J. A. Robertson, of Manchester, to read his paper.

CENTRALISATION OF ELECTRICITY PRODUCTION

By J. A. Robertson, M.I.E.E., M.I.Mech.E.

The advantages of a cheap and adequate supply of electricity for industrial, domestic, and other purposes are generally recognised, and in this paper it is proposed to deal only with the question of centralised production of electricity as compared with local generation, and to discuss briefly the far-reaching proposals of the Report of Lord Weir's Committee, issued by the Government in the early part of this year. The subject is not new, and since the striking address of Dr. Ferranti in 1910, many reports by Committees and experts have been made public.

In 1918, a committee appointed by the Board of Trade, under the chairmanship of Sir Archibald Williamson, issued a report in which they recommended the division of the country into districts for the purpose of electricity supply, and the concentration of generation in a comparatively small number of large stations equipped with modern plant and favourably situated for cheap coal and adequate water supplies. It was proposed that Joint Electricity Boards composed of members representing the existing supply authorities, and certain other members elected to represent the manufacturing and railway interests, should take over the existing stations and transmission lines in their respective districts, and construct new stations and transmission lines as required. The Report was followed by the Electricity (Supply) Act introduced by the Government in 1919, to carry out the main recommendations of the Report. This Act also set up a body of Electricity Commissioners, to promote, regulate, and control the supply of electricity in the country, and provided for the setting up of Joint Electricity Boards as recommended by the Report. The Bill, as it left the House of Commons, contained compulsory provisions with regard to the acquisition of stations and transmission lines, which were afterwards deleted in the House of Lords, with an understanding that they would be incorporated in a new Bill during the following session. This understanding was not fulfilled, with the result that it has been left to voluntary co-operation amongst the local authorities to set the machinery of the 1919 Act in operation. Schemes have been prepared and inquiries held by the Commissioners in most of the districts into which the country was provisionally de-limited, but the progress made has been by no means proportionate to the time and expense involved. A certain amount of co-operation has taken place, but generally speaking it has been found that the authorities were unwilling to transfer the ownership and control of their stations to another authority or to incur financial obligations for works outside their own district. Instead of Joint Electricity Authorities, so-called "Advisory Boards" were set up to advise the Commissioners regarding district developments. It may be confidently said that the work of these Boards has been largely superfluous, and the extensions which have been made during the last five years would have been carried out had there been no Boards in existence. The failure to achieve co-ordination amongst existing authorities has served to emphasise the necessity for additional powers, and the present Government, shortly after coming into office, appointed a committee under the chairmanship of Lord Weir, to review the whole position and to make recommendations as to the measures which should be adopted. The Committee submitted the report to the Government in May 1925, and the proposals contained in the report have, with certain modifications, been incorporated in the Electricity Bill, 1926, which has passed its second reading and is to be reported to the House, after a searching and exhaustive examination by a standing committee. It appears that the Bill—with probably some minor alterations—will become law before the end of the year. Before examining the proposals in the Bill, it is necessary to refer briefly to the present position both as to generation and transmission.

Generation

The electrical supply industry in this country dates back to 1883, when the first Electric Lighting Act was passed, enabling local authorities and private companies to obtain powers to supply electricity in certain specified areas. These areas, coinciding in most instances with local Government boundaries, were necessarily small. The means for generation and transmission of high voltages had not arrived, and the voltage of supply was generally limited to the pressure suitable for incandescent glow lamps which at that time did not exceed 110 or 120 volts. Within the next 15 or 20 years, hundreds of small generating stations, with restricted areas of supply and with different systems and pressures, sprang up all over the country. Under the conditions then existing, it was perhaps inevitable that different systems should be adopted, but the unfortunate result has been that we have at the present time some 572 authorised

undertakings, with powers to supply electricity, owning 438 generating stations. There are, in addition, about 103 stations owned by railway companies, tramway authorities, and non-authorised undertakers, which brings the total up to 541. The want of co-ordination had led to the adoption of different systems of supply, and in London alone there are 70 generating stations, with 50 different systems and 20 different supply pressures.

The average cost of supply for all purposes for the year 1923 was 2·17d. per unit, and the consumption of electricity from the public supply stations 110 units per head. In view of the comparisons which have been made between the consumption of electricity per head in this country and in other countries, it should in fairness be pointed out that the conditions are widely different. In this country we had for many years a cheap supply of good quality coal, widely distributed, and in close proximity to the industrial areas. During the development period between 1895 and 1912, small coal suitable for steam raising, could be purchased in most industrial districts for 7s. to 9s. per ton delivered. At these prices it was hardly possible in many districts to make out a case for the purchase of electricity if the latter had to bear heavy transmission costs. It was cheaper, indeed, to convey coal to the factory than to convey electricity. On the other hand, in those countries where electricity supply showed rapid development, like Norway, Sweden, Denmark, Switzerland, and Italy, coal was scarce and dear, and even France, Belgium, and Germany were unable to supply their own requirements and imported considerable quantities of coal from this country. Because of our cheap coal, we had the cheapest gas in the world, and this for many years was a formidable competitor to electricity supply. There are other reasons, such as the employment of water power, which is a comparatively negligible quantity in this country. Certain other countries use large amounts of electricity for special purposes like irrigation of the land and for processes special to themselves. This naturally increases the units consumed per head of the population.

The possibility of centralising the production of electricity on a large scale is really due to the invention and development of the steam turbine, a British production which we owe to the genius and skill of a British inventor, Sir Charles Parsons. Starting with small generating units of 200 or 300 h.p., and progressing through stages of 5,000, 10,000, and 15,000 kilowatts, it is now the practice in large stations to install sets of 40,000 or 50,000 kilowatts or more, and one set recently ordered by an American Supply Co. is said to have a capacity of no less than 130,000 kilowatts. With increasing size, there has been a corresponding development in design with improved efficiency, so that the turbo-generator in large units is now beyond question the ideal prime mover for the production of cheap electricity. The improvement in central station equipment has extended to the steam raising and auxiliary plant, and the modern power station with mechanical handling of coal and ashes, with high steam pressures and superheat, and with every device installed to ensure efficiency and economy, shows a degree of progress which is probably without parallel in any other industry.

Transmission

Under the conditions obtaining in this country, the transmission of electricity has not kept pace with its generation. This is due to the compact nature of the areas supplied and to the prejudice against overhead transmission in any but sparsely populated areas. A considerable amount of underground cable for pressures of 22,000 and 33,000 volts has been laid, but there are problems in connection with the manufacture of these high tension cables which have not been entirely solved. The cost of underground transmission is comparatively high, being at least twice the cost of overhead transmission, and for reasons already indicated it has been found more economical to generate electricity locally than to transmit over distances of more than a few miles. Our backwardness in this respect is very striking to anyone who has visited the Continent in recent years

and seen the countryside covered with steel towers and high-pressure lines, carried in many cases through populous districts and tapped to supply secondary lines—also overhead—for furnishing supplies *en route*.

Turning now to the proposals in the Weir Report Scheme, it is proposed—

(*a*) To create a new body to be called the "Central Electricity Board" with administrative and financial powers to carry out the provisions of the scheme.

(*b*) To close down 432 existing generating stations and to produce the whole of the energy required in the country in 58 selected main and secondary stations, of which 43 are existing and 15 are new.

(*c*) To construct a "grid-iron" of high tension transmission mains interconnecting the selected stations and coupling up with existing regional transmission systems and the other existing stations. A sum of £25,000,000 will be required for the first section of the "grid-iron," which is to be constructed during the first five years.

(*d*) That all energy generated at selected stations is to be purchased by the Board. This energy to be resold to the owning authority of the selected stations at cost price plus administration charges to the full extent of the local requirements of the aforesaid owning authority, and the balance will be sold by the Board to authorised undertakers for distribution in their respective areas.

(*e*) That the new stations required, and extensions to existing stations are to be constructed by existing owners, the capital to be raised under Government guarantees as to principal and interest. If the owners are not prepared to carry out such extensions the Board will make the extensions themselves. The owners of selected stations are to operate them in accordance with directions of the Board and in the case of dispute the Board may acquire the station themselves at a price determined by a schedule in the Act.

The total expenditure estimated for the whole scheme is £250,000,000 of which it is estimated that one half will be required to develop distribution schemes and will be raised by the local authorities or the companies who own and operate these systems.

The experts who framed the technical estimates assumed that the generating costs in selected stations will amount to not more than ·31d. per unit, and main transmission costs to ·03d., making a total of ·34d. per unit for high tension energy delivered for distribution. The average cost for distribution for all purposes, lighting, power, &c., is taken at ·5d., making a total cost of ·84d. per unit. Making allowance for administrative charges, it is estimated that the average selling price over the country will be reduced from the present figure of 2·17d. per unit to 1d. per unit or less. As a result, it is anticipated that the consumption of electricity will increase from 110 units per head to 500 units per head, or an increase in the total consumption from 4,000 million units to 20,000 million units per annum.

The scheme is certainly not lacking in boldness of conception or breadth of vision, and if realised, will bring us to the "electrical age" visualised by Dr. Ferranti sixteen years ago. It has aroused criticism in many quarters, including existing supply interests. The benefits—if anticipations are realised—are readily granted, but the estimates of results have been questioned, and the financial and administrative proposals have aroused strong opposition.

Turning to the estimates, the generating cost of ·31d. per unit is certainly much lower than the average cost to-day, but is very little lower than the corresponding costs in several modern stations in this country. The improvement in generating efficiency during the last few years is hardly realised by the general public. As an example, I take the South East Lancashire district, which is fairly typical of industrial districts in the country. In 1919-20 the average coal consumption of the whole of the electrical undertakings was approximately 3·1 lb. per unit generated. In 1923 it had fallen to about 2·2 lb. per unit, and for the year ended March last it was approximately 1·9 lb. This is for the whole

of the stations, good, bad, and indifferent. In the larger stations the consumption is as low as 1·6 lb. per unit. The total working costs in these large stations to-day is not more than ·2d. per unit, and in some cases less. Assuming the construction costs of new stations to be not more than present-day prices, and having regard to the lower capital charges as a result of Government guarantees, the total estimated cost of ·31d. per unit is, I am sure, a realisable figure under the conditions set out in the scheme. With regard to the cost of transmission, the figure of ·03d. per unit must obviously be to some extent speculative and the actual cost cannot be ascertained until the nature and extent of the transmission lines has been definitely decided. The cost of ·03d. per unit to cover capital charges and transmission losses appears on the low side, but even if the amount is increased by 25 per cent. it will not substantially affect the total cost of energy delivered to the consumer. It may be assumed that the cost is based on overhead transmission at pressures of 66,000 and 132,000 volts.

Accepting the estimates of generation and transmission in the report and assuming the "grid-iron" constructed delivering high tension energy at approximately ·4d. per unit, there still remains the question of energy consumption, estimated in the report to be 500 units per head in 1940. The success of the scheme depends entirely on the estimated increase being obtained, and if this estimate is not realised the "grid-iron" may become a burden instead of a help to the supply industry. It is estimated that in addition to the average consumption of 110 units per head from public supply, there is a further consumption of electricity from private industrial plants and small generating stations, which it is estimated would bring up the present total consumption to 200 units per head. The electricity now produced in this way would no doubt in nearly all cases be taken from the national "grid" when supply is available. There still remains a balance of 300 units per head to be obtained from other sources. What are the sources available ? There is at present a rapid growth in the use of electricity for lighting and for domestic purposes, which is certain to be accelerated under the scheme, but this is hardly likely to account for more than an increase of 50 units per head. The electrification of railways would, of course, provide a substantial and remunerative load, but for some reason railway electrification in this country, except for London suburban traffic, has made very little headway, and we compare most unfavourably in this respect with America and Continental countries. It has been demonstrated by experts whose authority is unquestioned, that electrical operation of the railways, with its many advantages, would cost no more than the present system. The slow progress of railway electrification is to some extent due to differences of opinion as to the choice of the system to be employed. In the meantime, at any rate, the railway demand cannot be considered an important factor in the realisation of the Weir scheme. There remains, then, the growth of the demand for electricity for industrial purposes.

In many industries the advantages of electric driving are so great that it has been brought into fairly general use, although the cost of electricity has been comparatively high. These industries comprise shipbuilding, general engineering of all kinds, and many others. It may be interesting to note that there are a large number of collieries in this country purchasing electricity from supply authorities in preference to generating it themselves. Public supply comes out most favourably where the power using machines are scattered, and the demand is intermittent. There are industries, however, where progress in adopting electricity has been comparatively slow. In these cases a large amount of steam is required for process work. This steam must be raised in any case, and the additional steam necessary to drive the mill engine or turbine has been looked upon as a kind of by-product, which costs nothing except the additional coal consumed by the boiler fire. The most conspicuous example of these conditions is the textile industry, and it is not surprising that manufacturers in this industry have been slower to realise the advantages of public supply than in other industries requiring similar amounts of power. Another reason is that textile mills as at present

constructed appear to have been designed for central driving, and the power can be transmitted from the engine to the point where it is required with the minimum of shafting and intermediate gear. In the early days of electricity supply, the supply authorities did not even consider it possible to quote prices which would compete with local power production in textile mills, and the location of the central electricity station and its equipment, while suitable for local traction and lighting requirements, did not permit of economical extension on a scale sufficient to supply the textile load. The position changed during the war, owing to increased prices of fuel and labour, and some activity on the part of a number of supply authorities in modernising their stations by installing larger and more economical generating plant. The prices for public supply for textile driving during recent years have varied in Lancashire from about ·55d. per unit to ·8d., the average price being about ·65d. At this price, a number of mills have found it remunerative to change over to public supply, and in all cases, I believe, the results have been entirely satisfactory. In practically all these cases electricity has been adopted to supersede existing power plant, and in this respect is at a disadvantage when comparisons of cost are made. In the case of new mills, with a public supply available at the prices indicated, there would be no question as to the most economical method to adopt. A retarding feature has been the introduction in textile mills of small turbines of 300 to 500 h.p., which can be either used for complete mechanical or electrical drive or a combination of both. These turbines are generally designed for "steam bleeding," the steam being taken off the turbine at suitable pressures for process work. Under suitable conditions the thermal efficiency is comparatively high. In a recent case where the power requirements accounted for 60% of the total volume of steam to be raised, and process requirements for the remaining 40%, it was estimated that public supply would require to be given at not more than ·45d. per unit to compete with local generation. This was probably an exceptional case, and the general opinion appears to be that if electricity can be delivered as low tension energy at a price between ·5d. and ·6d. per unit, it will be generally adopted for textile purposes. Incidentally, it may be said that electricity could be employed with advantage for a good deal of the process work for which steam is now considered necessary, the only question being that of the cost of supply.

The outstanding advantage of electricity as a motive power in the textile industry, is the fine steady drive on the machinery, and in numerous cases where it has been adopted the result has been increased output and a better product. Steadiness in the drive is obtained in the highest degree when each textile machine is driven individually by its own electric motor but can also be quite satisfactorily constant when a motor drives a group of machines in its immediate neighbourhood. When the transmissions by rope or belt and line shafting become lengthy, cyclical irregularities are frequently set up which become more pronounced as the transmission grows longer, and if the power is supplied by a reciprocating engine, these irregularities—existing as they do in no small degree in the very source of the power, are exaggerated at each stage of the transmission and become a serious factor in limiting output. It is impossible in the limits of this paper to go into much detail regarding the employment of electric power in the textile industry, but I would like to emphasise the danger of generalising from isolated experience. It is important also to remember that while very little, if any, increase can be expected in the efficiency of private power plants, the effect of co-ordinating electricity supplies on the lines of the Weir Report is bound greatly to improve the efficiency of public supplies and so reduce the cost.

It is impossible to generalise where there are so many variable factors to consider, and local conditions must necessarily decide between public supply and private generation in most cases. In making a comparison, however, all the factors should be taken into account. In the case of an existing private installation, the capital has already been spent on the power plant, and interest charges do not enter into consideration, but an allowance should be made for

depreciation. The value of the buildings and the ground occupied should also be considered if these could be used for production purposes. Rates and taxes, water, and other items of cost should be included, and although it is not usual to debit any proportion of management charges against power costs, the indirect benefit of relieving the management of the responsibility of operating a power installation should not be overlooked.

The question of spare or standby plant does not arise in the case of the usual mill engine, which is probably the most reliable type of prime mover in existence, but in the case of steam turbines the same measure of reliability cannot be claimed, and in view of the serious loss which would result from a total shut-down due to a breakdown of the turbine or its auxiliaries, it is desirable to have spare plant available, or at least to divide the power production between two or more units.

There are undoubted advantages in having what is practically an unlimited supply of power, which may have no direct effect on the power costs but which have a beneficial effect on the operating conditions of the mill. When all considerations are taken into account, the only limits to the use of electricity for textile purposes have been fixed by commercial considerations. To what extent will this limit be altered by the national scheme ? The estimated average selling price of 1d. per unit as a result of the scheme is, of course, for all classes of supply, and includes distribution costs amounting to over 50% of the total price. These distribution costs are chiefly incurred for lighting and small power supplies, and it is usual to fix a price for large power supplies considerably below the rates charged for lighting. Assuming the same ratio is maintained for energy supplied from the national "grid," it is probable that the price for lighting purposes will be from 2d. to 3d. per unit, while the price for power supplies may vary according to load factor from ·35d. to ·6d. per unit. The average price for power should certainly not be more than ·45d. per unit. It will be granted, I think, that under these conditions the commercial limitation which exists to-day is of a temporary nature only and will disappear when the national scheme comes into operation.

The other important limitation to a national scheme is the existence of a number of medium-sized stations which are favourably situated for coal supplies, and have natural condensing facilities for a limited output. There are a certain number of these stations in the textile districts, where coal supplies are well distributed, situated near canals, from which condensing water can be drawn sufficient for loads of 15,000 or even 20,000 kilowatts. These stations have been modernised and the old plant supreseded with modern turbo-generators of 3,000 and 5,000 kilowatts capacity each. The original capital expenditure has been almost, and in some cases entirely liquidated, so that there is only the "running charge," and the capital charges on the modern plant to be considered. In a number of these stations it will be difficult to make out a case for purchased energy from the "grid-iron" if heavy charges have to be incurred for local transmission lines, transformers, and switchgear. It would appear that a number of these stations will continue to operate, although not included in the list of "selected stations."

It is not the intention of this paper to comment on the administrative provisions of the Electricity Bill. A considerable amount of criticism has been directed to the proposed arrangement between the owners of selected stations and the Central Board. The separation of ownership from control,it is sitated, will lead to difficulties in operation and provides no incentive to initiative or efficiency. It is also pointed out that the geographical situation of the smaller power stations is such that a bulk supply could not be furnished except at a loss, which must fall on the users of electricity in the larger towns. Much of this criticism may be justified, but so far there are no alternative schemes put forward which could claim to fulfil the objects aimed at.

In the only practical alternative which I have heard put forward it is proposed to combine the generation of electricity with the manufacture of gas and certain by-products by a low temperature carbonisation process. It is pointed out that the industries of the country have grown up around the coal producing districts, and that a scheme for generating at the pithead—meaning from a group of closely-situated collieries—would obviate the necessity for an expensive "grid-iron." A reference to a map of the coalfields of Britain will show that this is true at least for the chief industrial districts. The chief item in the generating cost is still fuel, which in a modern super-station accounts for 60% to 70% of the total generating cost. Proposals of this kind have been brought forward from time to time, but hitherto it has not been possible to show commercial results, due to the difficulty of disposing of the by-products at remunerative prices. The chief of these by-products is coke, and so far it has not been possible to produce a coke which is suitable either for domestic use or for raising steam in a boiler furnace. It is claimed that the difficulty with regard to the latter has been overcome by the introduction of pulverising methods, which enables the coke to be burned as a fine dust is a specially constructed furnace. It is also pointed out that there is generally a large percentage of low-grade fuel produced from the coal mines which is not worth the cost of transport if a market has to be found more than a few miles away. This fuel in pulverised condition could be mixed with pulverised coke and employed to raise steam for driving turbo-generators. Natural condensing facilities would probably be absent, but it is claimed that cooling towers at a comparatively low capital cost could be employed, and that the loss in efficiency as compared with river water (which frequently involves heavy expense in constructional work) is not more than 8 per cent. This difference, it is said, would be more than neutralised by the reduced cost of fuel. A further possibility in connection with the pre-treatment of coal is the production of oil fuel, which is now extensively used in the Navy and Mercantile Marine.

The question of low-temperature carbonisation receives only a brief reference in the Weir Report, but it is inferred that any power which can be economically generated in conjunction with low-temperature carbonisation, would be delivered to the "grid," thus finding a ready market. It must be remembered that the Weir scheme only lays down the general lines of development, and that detailed schemes have yet to be prepared and submitted for the various districts. The most that can be said is that before any system is stereotyped for the whole country, further inquiry should be made in any direction which will not only produce cheap electricity but conserve the greatest and most important of our national resources.

The only other alternative—if it can be called one—is to leave things as they are and allow what is called "natural development" to go on. It is pointed out that a number of small stations have been voluntarily closed down in favour of bulk supplies, and that the process of concentrating generation should be gradual and not forced beyond its natural and economic rate. Those who put forward this contention are obviously overlooking the experience of the last five years. When the compulsory clauses were deleted from the Electricity Bill of 1919, it was confidently asserted that voluntary co-operation would take place and that the objects of the Bill could be achieved without introducing elements of compulsion. The contrary has been the case, and the causes which rendered co-operation impossible still exist. In this connection one has to remember the different type of authorities who are at present entrusted with public electricity supply. There are some 335 local authorities and 237 companies, including 28 power companies, with statutory rights of supply. The companies, other than the power companies, are nearly all purchasable at specified dates by the local authorities, but the power companies hold their rights in perpetuity. The chief obstacle to co-ordination has been the unwillingness of local authorities to take bulk supplies from the power companies, as an alternative to extending their own stations or constructing new stations. These

authorities contend that the security of the public rates enables them to borrow capital at 2% to 3% lower than the rates of interest paid to the companies' shareholders, and even where technical conditions may be favourable, they strongly object to handing over the generation of electricity, which they regard as a public utility, to a company whose primary object is naturally to make profit for its shareholders. The question of municipal versus private ownership of public utilities is outside the scope of this paper, but it is necessary to state that the existence of these two types of authorities, operating individual systems which ought, in the interests of the district and the nation, to be under centralised control, has been a serious hindrance to co-ordinated development. The Weir scheme is the first real attempt to overcome this difficulty. Under the scheme, the Board will itself buy all the energy from selected stations, both municipal and company owned, at a price which includes and limits the profits to be charged by the companies. This energy will be sold direct to the distributing authorities, and provision is made so that the benefit of cheap generation will be passed on to the consumer.

A legitimate fear is being expressed that the scheme is too big to be carried out and operated by one central authority. It must be remembered, however, that the Bill re-enacts the provisions of the 1919 Act regarding joint authorities, with the important difference that instead of the authorities interested putting forward a scheme the Commissioners themselves will formulate schemes which will include provision for carrying out works for the development of supply within the various districts. It would appear that the simplest way to carry out the Weir scheme will be for joint electricity authorities to be set up over districts which will probably be larger than was contemplated under the 1919 Act, and that a scheme for each district, including new stations and transmission lines, should be carried through under the supervision of the Central Electricity Board. As the districts become gradually reorganised, they will probably interconnect with each other, so leading up to the complete national scheme. The provision made in the Bill for financing the new stations and the construction of transmission lines would apply to the district schemes, provided, as would be the case, the district scheme conforms to the national scheme.

The subject is one of great national and industrial importance. The demand for electricity which will arise when trade conditions improve will call for an immediate and adequate source. With hardly an exception, it is agreed that the method of leaving the supply of what is now a national necessity to individual owners of supply systems, who are bound by circumstances to take a narrow and local view, cannot be continued if this country is to regain its former position in the world of industry and commerce. The Weir scheme is no doubt open to criticism, but it is at least a bold and comprehensive effort to deal with a problem of great complexity and pressing urgency. The expenditure on the scheme may seem large, but it is probably less than would be incurred if individual development were allowed to proceed. It is no use at this time of day to condemn legislative interference with the natural development of an industry. A cheap supply of electricity is a national question. It has been and must continue under statutory authority. It is closely related to questions of transport, housing, and the conservation of fuel. Existing methods having failed, it is the nation's duty to take what steps may be necessary to achieve the object on which all parties are agreed. If all those interested will take a broad view and look at the question apart from existing interests and local sentiment, with full regard to the future growth and prosperity of the country, they will co-operate and assist to carry out a scheme which, if realised, will prove of incalculable benefit to the nation.

Discussion

Mr. J. K. Kerfoot (Sidcup) thought it would be interesting for the members of the Institute to be informed as to the progress of the Municipal Electrical Station in Shanghai. He understood that Mr. Robertson had all the details of

the installation. When he, the speaker, was out there in 1913, the engines and boilers of his mills were already over-loaded, and he approached the Municipal Council with a view to obtaining a power supply. Up to that time the municipality had not catered for power purposes, but had devoted their attention to supplying the lighting demand of Shanghai. By the installation of five motors it was found possible to start up 10,000 spindles and preparation machinery, and from that period the electrical installation at Shanghai had become one of the largest power generating plants in the world. All this progress had been made in thirteen years. The question might quite reasonably be asked as to how all this arose. In 1920 there was a very big boom in cotton mill construction in Shanghai, and the Chinese thought it would be cheaper for them to obtain their current from the municipal authorities. Therefore, all new mills were installed with electrical driving, and there were now power plant units of 25,000 kw. in the central generating station. Nowadays, all the cotton mills, silk mills, and rice mills were supplied with electrical power. It was quite possible that some benefit would thereby accrue to Lancashire, because the engines and boilers in the old mills were obsolete and there was a general tendency to install the electrical power drive. The same practice could, with advantage, be adopted in the case of a great many Lancashire mills. Wherever a power plant was consuming more than 2 lb. per horse power per hour, and current could be supplied at a cost of approximately 0·5d. per unit, the plant should be scrapped. Being the first one to apply to the Shanghai Municipal Council for a power supply, he obtained considerable concessions from the Council, who had used his mills for advertising purposes. The engines in the old mills had been running for 23 years night and day, and, quite naturally, the boilers were past their prime. More steam was required for bleaching and dyeing, so he reduced the steam pressure on the boilers and converted all his weaving—5,000 looms—to electrical group driving, and the scutching-room machinery was driven by individual motors. His experience led him to believe that, with the exception of the scutching-room and for bleaching and dyeing machinery, group driving was to be preferred for ring frames, mules, and preparation machinery. He endorsed the opinion expressed by Mr. Robertson, that the time had arrived when Lancashire manufacturers would have closely to examine the cost of their power. If Lancashire and Yorkshire manufactures could be developed upon the lines of centralised electricity production, then the right course to adopt would be to drive the mills electrically. He had no hesitation in saying that the production throughout the mills, both as regards quantity and quality, was superior with the electrical drive. At the same time, it must not be overlooked that the great success which had been made of the Shanghai Municipal Electrical Station had been brought about by the constant power-load required by the mills—24 hours per day and six days to the week the year round. Although the station had to supply lighting for over 1,000,000 inhabitants, the engineer had informed him that it hardly counted in their cost of running the installation. The coal used was imported from Japan and of a poor quality, only containing about 6,200 calories and costing about 20s. per ton. Even in this country, with a much better quality of coal, say at 16s. per ton, the success of the large electrical stations and their ability to supply current inside the 0·5d. per unit, would depend very much on a large constant power-load during ten hours per day and a large increase in the consumption of current for domestic purposes.

Mr. G. Clapperton (Atherton) said he was connected with a firm which had an electrical plant, and he was informed that it would be doing the firm a good service to take out the motors and put the old engine back. He had noticed that since the scheme was mooted there had been a considerable number of police court prosecutions in regard to atmospheric pollution. Apparently, if electrical power plants were not installed from choice they would very soon have to be from compulsion.

The Chairman said that the three main items of expenditure in a cotton spinning mill were (1) the Cotton, (2) Wages, and (3) the Power. Dealing with the power, coal at 16s. per ton showed an advantage over electrical energy at anything like 0·45d. per unit, and thus turned the scale in favour of mechanical power. This was the main reason why progress had not been made in Lancashire in regard to the electrical drive. The cotton trade worked to very narrow margins, and there was a very small difference between loss and profit. For years past some of them had had mills fully equipped with electrical driving, and had been in a position to compare costs. At 0·45d., when coal was at 16s. per ton, the mechanical drive was greatly to the benefit of the mill as compared with the electrical drive. There was a steady, regular usage of power from the time when the mill started on the Monday morning until the Saturday noon. It was a standardised power, and the engines and boilers were fitted to meet the needs of the weight of the undertaking. It was necessary to be very careful in connection with the adoption of such a scheme as that described by Mr. Robertson, as it would be quite easy to injure industries very materially. The scheme outlined was unquestionably a magnificent one and, from the standpoint of the country, might have many advantages. Those who had had the privilege of visiting Sweden, Germany, and Switzerland, would know that every farm house, however remote from a town it might be, was lit electrically, and also that many appliances were driven electrically. It must not be lost sight of, however, that the reason was that coal was dear in those countries, and that a general supply of electrical energy was part of the national programme for other purposes and for other ends. He had no objection himself to the adoption of such a national programme for this country, but he had a very great objection to setting up a Board, say in London, which would attempt to deal with the great industries of the country they knew nothing whatever about. He also felt a great amount of diffidence in agreeing that there should be built up a common system of prices. In the latest amendments to the Bill, some variations were to be permitted and the standard was to be based upon the price paid for coal at the present time. They were all looking forward to a great development of electrical enterprise in the next few years in the big centres of industry, the interests of which must be sufficiently protected from contribution to the cost in respect of more remote districts. It appeared certain that small outlying townships, villages, and farm houses, &c., would be subsidised under the Bill at the expense of the great industries of the country. It was a feature which did not appear upon the surface, and one had to read the Bill very carefully to realise it. If the great industries could be placed upon a plane equivalent to that they would be on if they installed big batteries of their own—because they could beat anything which had been shown in the Bill in connection with costs—then those industries would back up the Government whatever their scheme might be, and work for a national plan. The cotton industries would have to be fully assured on that head, and proposals would have to be properly introduced. Words or promises could not be accepted; an Act of Parliament would be absolutely necessary. Otherwise there would be a fight against the Bill, and an endeavour to limit its operation in every way until such safeguards were introduced. The controlling heads of the large industries did not all work on one plane of thought. A supply of electrical energy for power purposes was very convenient for the heavy iron industries, which required a big peak of power brought in at a given moment, and which did not wish to install immense engine power in order to meet that peak. It might be of greater advantage for them at the time when they were using electrical energy, to pay a very high figure for their current. It was quite another matter where there was constant steady usage week in and week out. Where there was a maximum and steady use differential treatment had to be provided.

Mr. J. S. Peck (Manchester) felt that the lecturer had given a very fair synopsis of the new Electricity Bill. He judged that Mr. Robertson did not consider the Bill to be perfect, with which view he agreed; nevertheless he thought it was better to have a measure which, although it might contain minor defects, had compulsion behind it than to leave the industry to continue in its present state of confusion. As usual, on the introduction of a new Bill, vested interests which might be, or which imagined they might be, adversely affected, offered serious criticism, much of which was probably unjustified. Many who had criticised this Bill had evidently never taken the trouble to study it closely and to understand its details. It would appear that every effort had been made to safeguard the interests of those already engaged in electrical supply; the special precautions taken to safeguard vested interests could be demonstrated by citing one particular provision—"If the limb of a tree interferes with the distribution network the owner of the tree will be notified to lop the limb within twenty-one days. If he objects, he may appeal to the Ministry of Transport, who causes an inquiry to be held. If the decision is against the owner of the tree he is notified that he must lop the limb, and if he fails to do so within a reasonable time the Board may cause the limb to be removed." Safeguard could scarcely be carried further. The lecturer, said Mr. Peck, has pointed out that as far as efficient generation of electrical energy is concerned, this country is abreast of any other; there are generating stations in Great Britain which, considering the conditions under which they operate, are giving results equal to, if not better than, those obtained in any other generating stations in the world. When it came to the question of distributing large amounts of energy over long distances at very high voltages, our experience was limited. There was something more in overhead transmission than the erection of towers and the stringing of wires on insulators. A comprehensive study, he thought, of the whole scheme of inter-linking and distribution should be made at once in a thoroughly scientific manner and in consultation with engineers who had had the greatest experience in connection with high-tension distribution systems. Such a course would undoubtedly save unnecessary expense later. The ultimate object of the new Bill was to make it possible to supply electricity at a minimum cost and to make it available to the maximum number of consumers. The Bill could, therefore, only succeed if supported by the community; the greater the support the cheaper the supply. While electrification of textile undertakings was increasing, there was still an enormous field to be developed. It was often difficult to demonstrate to a mill owner that his electricity bill of the future would be less than his coal bill of the past. The advantages of electrical drive had to be shown to lie along other lines. The value of these particular advantages was often difficult to assess, but the fact remained that those who had installed electric drive are, in general, satisfied as to the financial aspect. Not many years ago it was necessary to plead with a man who was equipping a machine shop to install electric drive, but to-day the builder of a machine shop would consider nothing else. He felt that before many years such conditions would obtain in the textile industry, and electric drive would be as universal in the textile mill as it now is in the machine shop.

Mr. John Crompton proposed that a very hearty vote of thanks be accorded to Mr. J. A. Robertson for his valuable address.

Mr. R. H. Friend (Manchester) thought that Lancashire mill owners had not taken so much to electrical driving during recent years, chiefly owing to the state of trade, and, secondly, owing to the cost of electrical power, which was certainly on the high side at present. But he thought they would all agree that the cost of power was a very small percentage of the cost of production. In fact, it represented a figure of only $1\frac{1}{2}$ to 4%. The lecturer had stated in the paper that the majority of textile mills were laid out for engine drive. This was certainly the case with most of the mills that he had visited in this country.

Generally speaking, a saving of power could be shown by electrification even in the mills laid out for engine drive, and it was always a good policy not to have all one's eggs in one basket. An article on the Electricity Bill, in a recent issue of the *Observer*, referred to comments in the German Press regarding the Bill. The article read as follows—"The carrying through of this great electrical scheme by England will considerably influence the future progress of German industry and, above all, German exports of industrial products upon the world market. We shall have a much more difficult fight on the world market owing to increased difficulties of industrial export and the progress created by the cheap cost of *production in English industry." He had much pleasure in seconding the vote* of thanks to Mr. Robertson for his interesting address.

Mr. Robertson, in replying to the discussion, said Mr. Kerfoot's experience with electricity supply at Shanghai was extremely interesting and was a good example of what could be done with electricity where the field was entirely new. He quite agreed that 2 lb. of coal per horse power was a good result. In his business he sometimes examined records of power costs and he found the results were generally expressed in indicated horse power. A consumption of 2 lb. per indicated horse power meant approximately 2·2 lb. per shaft horse power. Comparing this consumption with power station results, a consumption of 1·6 lb. per kilowatt at a power station was equivalent to 1·2 lb. per electrical horse power, so that the fuel consumption at a central power station for a given amount of power was slightly more than half what it cost in a mill. Another speaker referred to a price of ·83d. per unit, and he quite agreed that for textile purposes this figure was not a commercial proposition. If the price was paid in a Lancashire town, then it was considerably above the average price and would no doubt be reduced, because Lancashire was well ahead of the rest of the country in regard to cheap supplies. Regarding prosecutions for smoke nuisance, the mill owners had a duty as well as other manufacturers, and if they could, without serious financial loss, assist to abolish the horrible smoke pall which hung over most Lancashire towns, the expenditure involved would be a good investment. He frankly admitted that it was difficult for an impartial outsider to make accurate comparisons between the cost of private power production and public electricity supply. The President had stated that ·45d. per unit did not compare favourably with the cost of producing an equivalent amount of power by private plant. On the other hand, he knew a large manufacturer in Lancashire who began to electrify his mills about four years ago. He was very doubtful and hesitated over the matter for some time before he would agree to pay ·65d. per unit for low-tension energy. This price was offered with a basic coal price of 16s. per ton, with a variation in price corresponding to the actual cost per unit at the power station. This manufacturer was thoroughly satisfied with the results, and has since electrified several additional mills. This experience could not be ignored. There were, of course, always differences in management, &c., which might vary the power costs, and there were also different methods of calculating the total cost of power production at private installations. The President's reference to the provisions of the Bill which would result in a cheap supply of electricity for the villages and countryside at the expense of large towns was quite legitimate criticism. It should be remembered, however, that the Bill only provided the machinery for a national supply, and the operation of the machinery was to be entrusted to a Board of eight experts. It was not likely that these experts, some of whom at least would be commercial men, would expend large sums of money in supplying farms and wayside cottages if, by so doing, the price of electricity would be increased to larger industrial consumers. After all, there was nothing in the Bill which compelled a manufacturer to take a supply of current. If he so desired he would still be able to generate power from a private plant. The success of the National scheme depended upon the Board so adjusting the prices for the different classes of

supply as to obtain an enormous increase in the existing output of electricity. If the supply to country districts could only be given at a loss, then he agreed that it would be wrong for the industries of the country to bear it. It should be remembered, however, that one of the main factors in cheapening electricity supply was the variety in the demand from different classes of consumers. By combining the demand for industry with the lighting demand and the demand for traction, we obtained a diversity factor which appreciably reduced the cost of supply. The agricultural load would, as a rule, tend to improve this diversity factor.

Mr. John Crompton, Chairman of the Council, then took the chair and asked Mr. Percy Bean to read his contribution.

THE SIZING OF ARTIFICIAL SILK YARNS AND A COMPARISON WITH THE SIZING OF COTTON YARNS

By Percy Bean, F.C.S., M.Ph.S.

INTRODUCTION

The success attained in the weaving of single-fold artificial silk warp yarns during the last few years is due, in a great measure, to the improve ents brought about in the machines employed for the purpose of sizing. Just as sizing is essential to the successful weaving of single counts of cotton yarn, so it is essential that the filaments of artificial silk should be bound together by some adhesive substance, in order to strengthen them sufficiently to permit good weaving with a minimum of breakages. Sizing has been the means, undoubtedly, of adapting artificial silk yarns to the manufacture of more extensive varieties and qualities of cloth than formerly, and manufacturers may now use this yarn with confidence, knowing that it is a commercial article from which, in most cases, they can obtain the same loom-efficiency as from cotton. When artificial silk yarns were first used in conjunction with cotton yarns in the production of striped fabrics, the silk employed was usually two-fold, and, on this account, was sufficiently strong to withstand the operations of weaving without the necessity of sizing. It was found, however, that much of the lustre of artificial was lost by doubling, and, in order to obtain the full advantage of this essential characteristic of the new fibre, it was essential to use single yarns spun with as few turns per inch as possible. This of course made sizing essential.

EARLY METHODS OF SIZING ARTIFICIAL SILK YARNS

In the early days of this new industry it was customary in some works to carry out the sizing operations in the hank. A very simple machine was employed, and the hanks were placed on sticks and immersed in the bath of size. The yarn was worked gently for about ten minutes, and then the excess of size was squeezed off by hand. After sizing, the hanks were either taken direct to the hot-air drying stove, or they were placed in cotton bags and strongly hydro-extracted. It was claimed by many firms that they got better sizing when the yarns were first treated in the hydro-extractor, than when they were taken directly to the drying stoves.

Another form of sizing, known as machine, or "bobbin-to-bobbin" sizing, found favour about this time. In this process the yarn was run off from ordinary winders' bobbins through the size contained in a box, and then on to separate bobbins again. These latter bobbins were specially made for the purpose. They were made of aluminium and constructed with the shaft or barrel perforated with a number of holes in order to allow the yarn to dry more easily when they were placed in the stoves. The warps were afterwards prepared from these bobbins in the usual way. The advantages of this system were, that there was very little

tension placed on the wet yarn during the process of sizing, and none at all during the process of drying. This is a very important factor, as will be shown later. Unfortunately the production by this process was small, and therefore not economical except where a few ends only were required to produce the figure of the pattern. Consequently, it has almost gone out of use. It is a matter of interest, however, to know that "bobbin-to-bobbin" sizing is again attracting the attention of engineers, and an attempt is being made to reintroduce it on a larger scale, so as to enable a large number of ends to be dealt with in one run. It will be apparent that the main difficulty will be to construct a machine which will hold from 2,000 to 3,000 bobbins and yet be contained within reasonable dimensions.

PRESENT-DAY REQUIREMENTS AND A MODERN MACHINE

When artificial silk fabrics became more popular the older processes of sizing had to be superseded to meet the requirements of the trade, and machines of the type shown in Figure 1 were invented. These machines differ very considerably from those used in the sizing of ordinary cotton yarns as will be seen by comparison with Figs. 2 and 3. Without giving a full description of the machine at this stage, it will be sufficient to say that it consists essentially of a copper size box, in which revolves a brass roller, and a drying apparatus. The size is picked up from the surface of the roller by this method in sufficient quantity for weaving purposes, and no pressure is exerted on the yarns in the wet state as is customary in the sizing of cotton yarns on the tape frame. In the case of cotton yarns it is important that the size shall be well squeezed into the yarn between the individual fibres, and this can be brought about only by pressure from the squeezing roller, a pressure which would be harmful to artificial silk yarns in the wet state. After picking up the size, the yarn is passed over the drying arrangement. This consists, usually, of two steam-heated plates, or cells, arranged at an angle as shown in the drawing. These cells, which will be dealt with more fully later, are heated by steam, and worked at a pressure of about 25 lb. From the drying cells the yarn is passed to the weaver's beam. In the passage from the size box to the first drying cell there is a slight tendency for the yarn to "twirl," and this is a decided advantage, as will be explained shortly. "Twirling" is more pronounced on the ordinary tape frame or slashing machine, during the sizing of the coloured yarns which go to the borders of dhootie cloths, than it is on this machine. This is due to the longer distance the yarn has to travel from the size box to the drying cylinder, and it is the cause of a good deal of trouble, because the yarns have a tendency to twist or "twirl" round each other when the tape frame is stopped, or when it is running on the slow motion. Much of this trouble is due to the position of the coloured size box, as will be seen from the illustration. It is peculiar that what is the cause of serious trouble in one case has turned out to be a decided advantage in another, because the slight "twirling" in the case of artificial silk yarns allows the size to become twisted between the filaments from the point of contact with the first drying cell and the size box, and so rolls and binds them firmly together from the inside of the thread as well as from the outside. Whilst the distance between the size box and the first drying cell is sufficient to cause a slight "twirling" it is not sufficient to permit the different threads "twirling" round each other as described in the case of the coloured-border cotton yarns on the tape frame. There is no doubt that makers of sizing machines for artificial silk realised the danger of "twirling" if the yarn had to travel any considerable distance between the size box and the drying plate, and also the danger of over-stretching the yarn whilst in the wet state, and they constructed the machines in such a way as to avoid these troubles. It is quite certain that they never constructed a machine intentionally which would give the right amount of "twirling" to produce the beneficial results which have been found in practice. This is one of the happy accidents of which we have so many instances in the history of our manufacturing processes.

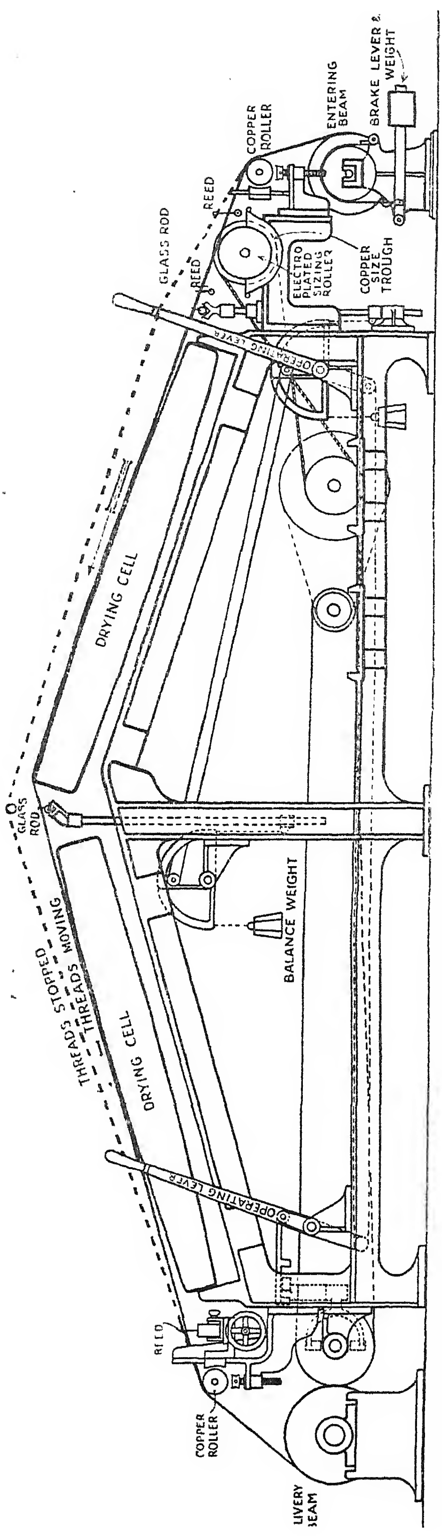


FIG. 1—Artificial Silk Sizing Machine.

Illustration prepared and lent by the makers, S. Walker & Sons Ltd., Radcliffe

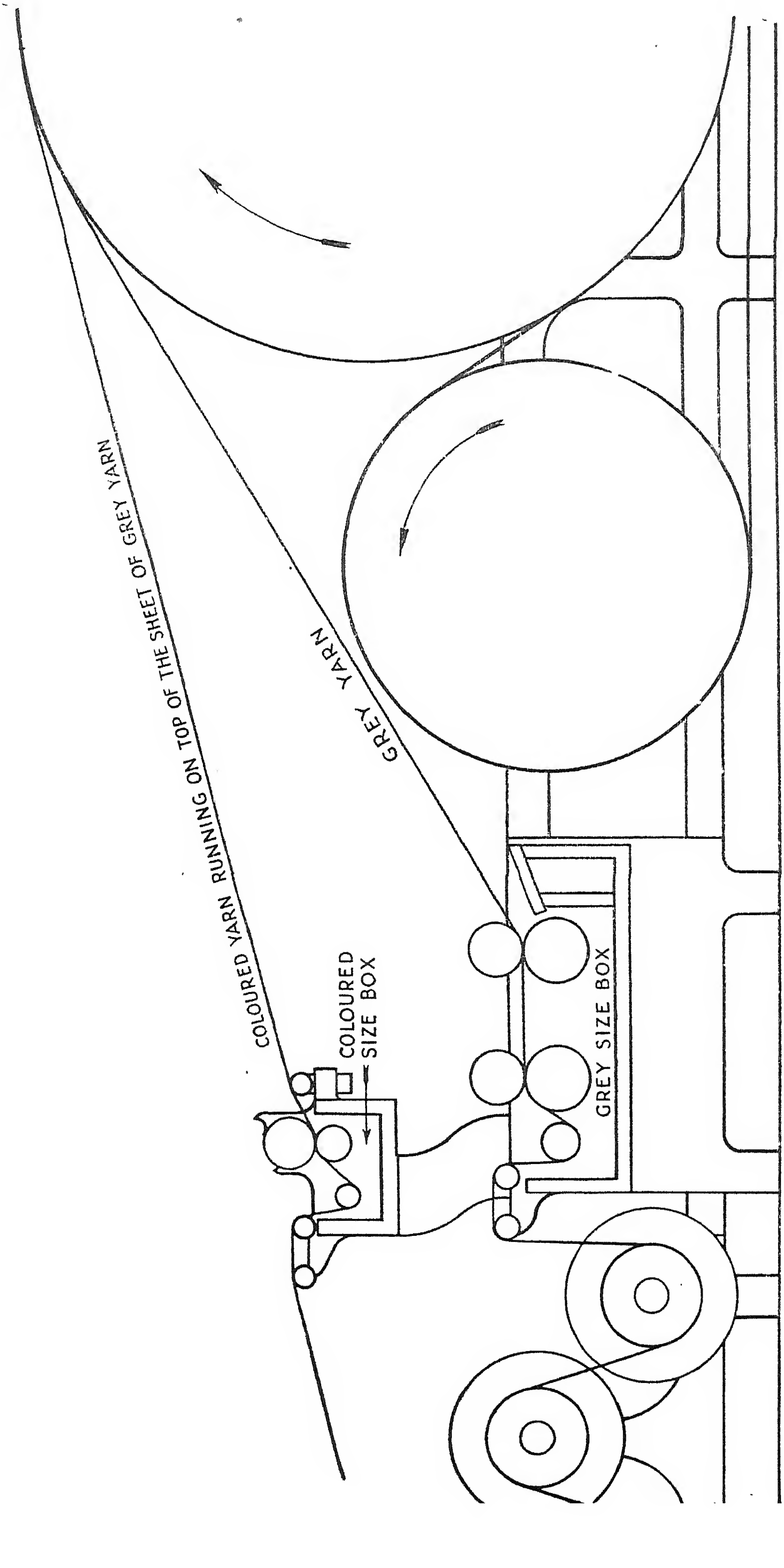


FIG. 2—Tape Sizing Machine running on the lap of the grey yarn on the drying cylinders.

The Illustrations from which this block and that for Fig. 3 have been prepared were kindly lent by Messrs. Howard and Bullough Ltd.

COMPARISON WITH THE SIZING OF COTTON YARNS

From what has been said already, it will be evident that the sizing of artificial silk yarns differs entirely from the sizing of cotton yarns. In the former case the sole object is to obtain the maximum amount of strength with the minimum amount of size. In the case of cotton yarns, even in pure sized yarns, a certain feel and appearance is aimed at, even if the goods are intended for bleaching and finishing. The only appearance desirable in artificial silk sizing is the retention of the lustre as much as possible, and, on this account, it is advisable to employ a size as transparent as possible. Experience has shown that thin boiling starches, or partially soluble starches, are more suitable for sizing artificial silk yarns than raw, untreated starches, such as farina, maize, &c. There are many makers of suitably treated starch, but it is not desirable to give names in a lecture of this kind. It may be stated, however, that a starch which will give a similar size to that produced by a mixture of equal parts of white dextrin and ordinary maize or farina may be considered a rough standard. It has been mentioned already that artificial silk yarns require very little size, and experience has shown that a mixing containing half a pound of suitable starch to one gallon of water is strong enough for all practical purposes. The starch should be mixed with water and agitated for a short time. Heat is then applied, and the temperature raised to about 200° F. Gelatinisation takes place, and this completes the process. The size is usually allowed to cool before use, on the machine, and in hank sizing this is a necessity for covenience of handling.

Although the sizing of artificial silk yarns is a very simple process in itself it becomes more complicated, and presents certain peculiar difficulties of its own, when the yarns are intended to be woven into stripes along with cotton yarns. This is partly due to the stretching or elongation of the artificial silk yarns which takes place when they have been wetted and then dried under tension. It has been found that under normal treatment in sizing, the yarn increases about five per cent. in length. This increased length is almost entirely lost if the yarn be again wetted and allowed to dry without being subjected to tension. The effect of this peculiar and characteristic property of artificial silk is important when the woven fabric is subjected to the processes of bleaching and finishing. The cloth is wetted during bleaching, and it is afterwards dried on an ordinary drying machine. During this process no direct tension is placed upon individual threads, and the artificial silk yarn loses much of the elongation which took place when the yarn was sized and dried under tension. If due allowance be not made for this when the artificial silk is sized in the first instance, and further if due allowance be not made by suitably weighting the weaver's beams when weaving, the cloth may come up puckered when it is bleached and finished, or the artificial silk yarns may be broken when the cloth is dried on the drying cylinders. It has been found that viscose silk yarn should be warped about 3% longer than ordinary cotton yarn, for the same length of woven cloth, in order to allow for the less tension which must be placed on the artificial silk beam in the loom than on the one containing cotton yarn, and a further allowance of 5%, as already mentioned, for the elongation of the yarn which takes place when it is wetted out in the sizing operation. Altogether, this is an allowance of about 8% for ordinary plain weaves and rather less for satins.

DETAILED DESCRIPTION OF MACHINE

I am indebted to Messrs. Samuel Walker & Sons Ltd., of Radcliffe, for the detailed drawing of the machine here exhibited. This machine is drawn to scale, and it is interesting in as much it is practically half the size of the actual machine itself. It consists of the following essential parts—

(1) The frame.
(2) The size box with roller or bowl and fittings.
(3) The drying cells or plates.
(4) Glass lifting rods and balancing motion.
(5) Driving motion.

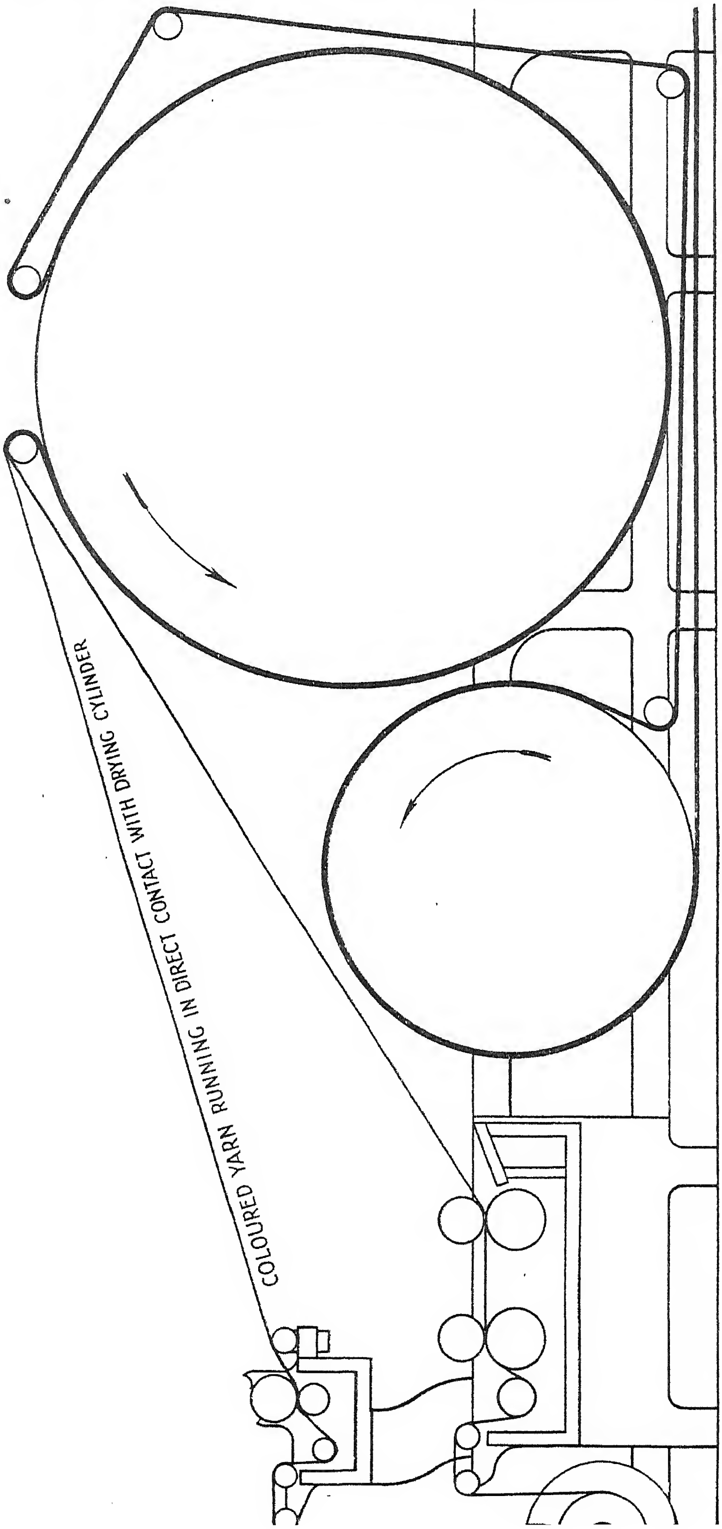


FIG. 3—Tape Sizing Machine showing coloured yarn running in contact with the drying cylinder

The Illustrations from which this block and that for Fig. 2 have been prepared were kindly lent by Messrs. Howard and Bullough Ltd.

The frames are made of cast-iron, and they are securely stayed together by means of wrought-iron bolts and pipes. The top flange of each frame is fitted with four square thread nuts and steel screws for supporting the drying cells, and for adjusting the same to the required angle. The total height of the frames from the floor is about 3 ft. 6 in., and this has been found to be the most convenient height for the average operator. The size box, which is usually constructed of copper, and which is semi-circular in shape, is fitted with an outlet flange at the bottom, to which is attached a let-off pipe and tap. The size roller, which is generally 6 in. in diameter, is made from solid drawn brass tube, and it is usually very heavily electro-plated. This roller, which is mounted on self-aligning bearings, revolves in the size at about 77 revolutions per minute, and in the same direction as the yarn is travelling. In order to adjust the contact between the threads of yarn and the size roller, a copper-tube guide-roller is fitted. This guide-roller which is about 3 in. in diameter, is adjustable by means of screws and suitable slide-bearings.

The drying arrangement consists of two flat chambers, or cells, placed at an angle to each other as shown in the drawing. The first drying cell is inclined upwards from the size box, and this allows the size on the threads to run backwards to the size box, thus assisting in giving a level coating to the thread, and so producing a level yarn which prevents the size "beading" during weaving. The result is there are less breakages of the yarn in the healds and reeds. The second drying cell is inclined downwards, as shown in the drawing. The surfaces of the cells are highly polished, and they should be kept free from grease and dirt. Between the two cells, and also between the reed and the first cell, a glass rod is placed. These rods are connected with lifting mechanism, which may be operated by hand levers from each corner of the machine. The purpose of the glass rods is to raise the yarn completely from the surfaces of the heated drying cells, and from the size roller, when the machine is stopped for any purpose during sizing. It may be as well to mention that the drying cells are usually supplied 77 in. wide on the face. They may be obtained, however, to suit any particular requirement. The cells are made from a special metal alloy, and they are constructed in such a way as to maintain an even temperature over the entire surface. To obtain this result the steam is caused to enter each cell at the highest point, and it is diverted across the inside surface in alternate directions by a series of baffle plates. The condensed water is delivered into a steam trap placed at the lowest end of each cell.

In conclusion I would like to point out that it is important that all sizing machines should be erected in rooms having good solid concrete floors if possible, and the rooms should be lofty, well lighted, and well ventilated.

Discussion

Mr. J. W. W. Shuttleworth (Clitheroe) said that the difficulties of sizing artificial silk were intensified by the fact that it was undesirable to stretch the yarn during the wet process. In starting up certain machines there was a tendency to rolling as the yarn left the sizing roller. If machines could be constructed in such a way tha , immediately they took up, the draw commenced in a perfectly even position, there would be no form of rolling, and thus numerous difficulties which rolling created would be eliminated. The ideal form of sizing artificial silk, in his opinion, was by eliminating the comb which expanded the yarn from the box and by taking it over cylinders in the same way as cotton. It was undesirable to have the threads glued together. There was yet considerable room for the exercise of inventive genius to develop forms of mechanical sizing for artificial silk. As the lecturer was one of the authorities on such matters perhaps he would inform members what mixing he would suggest for ordinary use in the sizing of yarns for weaving purposes. Could he supply a formula for a standard mixing ?

Another speaker also referred to the actual mixing of the sizes. Gelatine, either in its purest form or broken down, had been frequently mentioned in the literature. What was the effect of such gelatine mixed with either maize or dextrin, and what was the effect on soft materials of such sizes ?

Mr. J. Hollas (Preston) inquired what was meant by the statement that artificial silk was puckered when the cloth was finished ? He also wished for more information about its having been stretched and not having gone back.

Mr. F. P. Slater (Bollington) asked whether any serious attempt had been made to control the temperature of the machines.

Mr. J. K. Kerfoot (Sidcup) wished to know how an even temperature was maintained on the plates. Looking at the matter from an economic point of view, it seemed to him to be next to impossible to maintain an even temperature.

Mr. Bean, in reply to the discussion, said he had endeavoured to make it quite clear that the starch used should be a treated starch, i.e., starch which had been rendered partially soluble. The general experience was that the use of either gelatine, dextrin, or gums such as tragacanth, was undesirable because of the tendency of the yarn to stick. With a partially soluble or thin boiling starch sticking was avoided. This was found out some years ago with bobbin-to-bobbin sizing. If thin boiling starch was used there was no sticking of the size, although used on a bobbin. When a dextrin was used there was a good deal of sticking. In regard to the stretching and the puckering, it was necessary to remember that two yarns, differing very considerably in properties, were being employed in one fabric. In the case of the cotton yarn very little stretching took place during sizing. In fact, in good sizing practice as little tension as possible was put on the yarn so as to retain its strength for weaving. In the case of artificial silk yarn, a considerable amount of stretching took place in spite of every precaution. The result of this was that when the cloth was wetted out in the bleaching and finishing processes, and dried under little tension, the artificial silk yarn shrank more than the cotton in returning to its original length as before sizing, and so caused puckering of the fabric. A point had been raised in regard to the temperature at which the size should be used for artificial silk yarns. As already mentioned, it was necessary to use the size at a fairly low temperature on account of handling, and this was the case when sizing cotton yarn in the hank. Even when the sizing of artificial silk was conducted in the machine it was better to use the size at a fairly low temperature, say 60° to 80° F. It was different in the case of cotton yarns, because such yarns are made up of a number of very small fibres twisted more or less tightly. In this case boiling the size was important, as the ebullition and movement of the size assisted materially in penetration between the fibres of the yarn. It is a well-known fact that cotton had a tendency to resist penetration on account of the natural wax and fatty matters present acting as water-resisting media. At the present time temperature control in sizing cotton yarns was advocated, but he was firmly convinced that "hard boiling" was the best temperature for cotton yarns. In answer to a question in regard to the temperature of the drying cells on the machine shown on the diagram, Mr. Bean said that evenness was maintained by the use of a series of baffle plates, but he would prefer that some engineer who knew the actual construction of the drying cells would offer an opinion about this point. There were no means of heating the size in the size box, as it had been found that hot size was not suitable for artificial silk. The size was heated to the temperature previously mentioned in the beck used for its preparation and then allowed to cool before being used on the machine. "Cold" was a matter of comparison; a few degrees of temperature were unimportant.

Mr. W. Frost (Macclesfield) said that, as an old silk throwster, he was sure that the practical hints given by Mr. Bean demonstrated the importance of

paying attention to details which, though apparently small, if neglected led to serious consequences. He moved a hearty vote of thanks to the lecturer. The vote was carried by acclamation and the proceedings terminated.

A group photograph was taken of the company in attendance at the proceedings.

CONJOINT MEETING AT LEICESTER

Meeting at Junior Training Hall, Leicester, 15th October 1926;
Mr. T. Fielding Johnson in the chair.

Promoted by the Committee of the Lancashire Section of the Institute, the above meeting was held conjointly with the Leicester Textile Society. A special visit to the Textile Machinery, Yarns, and Fabrics Exhibition, by kind invitation of the Exhibition Directors, was associated with the event, and there was an excellent attendance. Prior to the meeting tea was served by invitation of the Directors.

Mr. Frank Nasmith, Manager of the Exhibition, introduced Mr. T. Fielding Johnson as Chairman of the meeting, and said that he was extremely pleased that the Textile Society movement at Leicester, which probably dated from a meeting held at a previous exhibition of a similar character, had developed in a highly satisfactory manner. The Chairman that afternoon had long been particularly interested in technical education and they welcomed his presence. Proceeding, Mr. Nasmith made reference to the work of the Textile Institute and particularly to the scheme by which membership could be associated with post-graduate qualification.

The Chairman said that not only was technical education of vital interest to the young men concerned with the industry, but he recognised that it was of great help to Leicester as the centre of the hosiery trade. The hosiery industry was Leicester's original industry. He had pleasure in calling upon Mr. Herman S. Bell, of Nottingham, to give a paper on "Thread Take-up in the Seaming of Knitted Fabrics," which appears in the Transactions Section of this issue (T583–T587).

A brief discussion followed the reading of the paper, and Mr. J. Chamberlain said that Mr. Bell had made a good start and should go forward with the subject. The advantage of special calculations depended greatly upon the conditions under which work was being carried out. The lecturer said that although factory conditions differed, yet he had secured his results from conditions of normal standard—normal fabrics and normal conditions—and he had set out to secure accurate results. The meeting ended with a vote of thanks to the contributor of the paper, to the chairman, and to Mr. Nasmith, Mr. Wm. Bastard proposing the vote as representing the Leicester Textile Society.

TEXTILE TEACHERS' ASSOCIATION

The annual meeting of this Association took place at the Textile Institute, Manchester, on the afternoon of Saturday, 6th November, when Mr. E. Cousins (Leigh) presided. There were members present from various parts of Lancashire and adjoining counties. The annual report and financial statement were adopted, after which Mr. Cousins proposed the election of Mr. J. W. Adamson (Accrington) as President for the ensuing year, the motion being heartily carried. Mr. Walter Bailey (Ashton) was elected Vice-President. A sub-committee was appointed to meet a committee of the A.T.T.I. in order to discuss the question of the establishment of National Certificates in connection with textile training in reference to the cotton industry. Messrs. Thornley, Oldham, Atkinson, and Wilkinson were re-elected to the Committee of the Association, and Mr. C. Barnshaw

(Blackburn) was re-elected Hon. Secretary, whilst Messrs. Pennington and Atkinson were appointed to attend a meeting of the Textile Institute Crompton Committee to consider revision of the scheme of competition.

The President (Mr. Adamson), in the course of an address, reviewed the work of the Association, which, he claimed, had performed considerable work of useful character, whilst the interchange of experience owing to the existence of the Association had been most beneficial. He urged that no opportunity should be missed of strengthening the Association's connection with the Textile Institute. He thought all members should be in membership of the Institute and, after that, should seek to qualify for the Diplomas of the Institute. It was not sufficient that textile teachers should be satisfied with ordinary membership, and he was certain that in the near future the Diplomas in question would be of great value. It was quite evident that the Institute was determined to maintain a really high standard of qualification. It was conceivable, in fact, that the securing of a Diploma of the Institute would become quite a necessity to the teacher of the future. If teachers as a body took up membership of the Institute, they could then see to it that they were adequately represented in the matter of direction of the affairs of the Institute, the constitution of which was on quite a democratic basis. If the majority of teachers could succeed in obtaining the Diplomas, then the standard and the prestige of the textile teacher would be enhanced thereby.

Mr. W. Wilkinson (Blackburn) suggested that in the matter of interpretation of the results of scientific investigations, it might be possible to arrange for a short series of lectures for teachers, possibly by some member of the staff of the British Cotton Industry Research Association. He hoped the Committee of the Association would bear this matter in mind.

NOTES AND NOTICES

Council of the Institute

At the monthly meeting of the Council, held on Wednesday, 17th November, at Manchester, several matters of interest were dealt with. Reference was made to next year's Annual Conference of the Institute, to be held at Bolton during Whit-week, the conference to form a part of the proceedings in connection with the local celebrations which are to take place in reference to the Centenary of the death of Crompton, the inventor of the mule. Already the Lancashire Section of the Institute had prepared a suggested list of papers for the Institute Conference, such papers referring to the historical aspects of subjects suitable for association with the celebration proceedings. The question of the introduction of general subjects was raised, and it was decided that the Committee named be requested to offer suggestions for additional papers of a general description. The Council also discussed the question of the use of the letters F.T.I. and A.T.I. by members entitled to do so, and it was agreed that public use of the abbreviations should be encouraged, but that in the Journal of the Institute the use generally should only apply to contributors of papers and to authors, according to the individual desire of such contributors. The General Secretary reported further communications from the U.S.A. with reference to the recent proposal for the organisation of the American members of this Institute. Mr. Charles H. Clark, of Boston, as Hon. Secretary, had written stating that at a meeting of the members it had been decided, for the present, to form a club. A report in reference to this organisation will appear in our next issue. The decision to style the organisation a club, however, does not preclude the future consideration of the formation of a definite Section of the Institute. Mr. Clark has asked for information on this matter, and it was agreed that a reply be sent by the General Secretary, after consultation with Mr. Frank Nasmith. The

Association of Special Libraries and Information Bureaux is inviting membership and annual subscriptions. The chief object of this organisation is to facilitate the co-ordination and systematic use of sources of information in science, industry, commerce &c., and the Association occupies for its offices part of the premises of the Institute at 38 Bloomsbury Square, London. It was decided by the Council to take up membership at £2 2s. per annum.

The Institute and Invested Funds

The policy of investment in connection with the Foundation Fund of the Institute and the application of the annual revenue by way of interest to special requirements, has succeeded admirably. The Foundation Fund is continuously open for expansion, and the total has been considerably advanced even in the course of the last few years—a by no means favourable period for augmentation. Adverse conditions notwithstanding, the experience of recent years suggests justification in expectation of further gradual expansion of the fund. Last year, addition to the extent of £525 was effected, whilst in the current year a sum of over £80 has been credited to the fund. The process of strengthening the financial position of the Institute by means of invested funds is to be further pursued as a result of a recent decision of the Finance Committee approved by Council. In the past, revenue from Life Membership subscriptions has been credited to income at the rate of 10 per cent. of the amount each year. As from the commencement of 1927, all Life Membership subscriptions received are to be invested and the capital retained. Moreover, due to the advent of the scheme under which diplomas are granted to members, and to the large number of admissions to Associateships and Fellowships in the early period of operation of the scheme, exceptional income by way of fees involved has arisen. As the scheme proceeds the annual revenue from fees may be expected to diminish gradually. Therefore, after apportionment of expense in connection with the scheme for the current year, the credit balance is to be invested. As the Institute continues to develop, the demands upon its resources irresistibly advance, and though the policy of investment may present temporary difficulty, yet there can be little doubt as to the satisfactory character of the ultimate result.

Design and Structure of Woven Fabrics

The Institute's annual competitions, which commenced in 1919 following upon the Crompton memorial gift, the annual revenue from which is applied to the provision of prizes with a view to the advancement of design and structure of textile fabrics, now form a prominent and well-established feature of the activities of the Institute. Since the leading competition was embarked upon, many modifications of the conditions of the competition have been effected. Experience has suggested changes which the Committee in charge of the scheme has readily considered. Moreover, the Committee has repeatedly invited suggestions for improvement of the scheme. Recently a special conference was held, at which the conditions of the scheme were completely canvassed. The result is that important amendments will, in all probability, figure in the conditions, when issued, in respect of next year's competitions. Although the Committee have not recommended alterations of quite so drastic an order as some of the delegates to the conference apparently desired, yet they had to consider the expression of highly divergent views. The decisions of the Committee may certainly be described as representing a genuine effort to achieve a fully satisfactory compromise. A considerable reduction in the total number of patterns required from participants in the principal competition is intended to improve the position of evening or part-time students as against the position of day students. When the amended scheme is launched, it is confidently anticipated that all interests affected will give whole-hearted support to it.

Advanced Standard of Achievement

One thing is quite certain—the scheme has achieved definite progress in reference to its chief aim—advancement in design and structure. The contributions of competitors for the prizes for the current year are considered a decided advance on any previously submitted. When the specimens become available for inspection, a very greatly extended measure of interest in the exhibits should accrue. The Council of the Institute may be expected to extend the facilities for inspection.* Although the adjudication is practically completed, the results will not be officially announced—according to Committee decision at the time of writing this note—until the distribution of prizes, which will take place at the Institute headquarters on the 11th December, when the specimens will be specially displayed. If possible the exhibition of the specimens will be continued on the 13th and 14th December. In addition to the display of specimens in connection with the principal competition, there will be interesting exhibits in connection with the special competitions, including the first entries in respect of the special prizes for yarns due to the generous offer of Messrs. R. Greg & Co., of South Reddish, Stockport, who have provided a sum of £25 for three years for this purpose. Though the specimens received have been few in number, yet the result is regarded as providing a really satisfactory commencement of the new competition. It is hoped, too, that other firms or organisations may be induced to help forward the expansion of the Institute's programme of competitions in regard to textile productions.

Institute Library—Accommodation and Additions

The acquisition of the library of the late Professor William Myers, apart from the satisfaction of securing a permanent home for the collection, has proved an addition of definite value, but has so increased the accommodation required that the matter has had careful consideration by the Committees concerned, and ultimately by the Council. The questions of shelf-room and of cataloguing have been debated, and are to be dealt with in that order. Meanwhile, it may be useful to reiterate the conditions upon which members may obtain books and periodicals on loan from the library of the Institute. A period of seven days is allowed and the only charge made is that of refund of outward postage; the borrower, of course, returning the book at his own expense. Many of the Journals from which the abstracts that appear in the Abstracts Section of this Journal are made, are received at the Institute, and members desiring to see the originals may borrow them upon the terms quoted. From time to time, individuals and organisations make gifts of books and periodicals to the Institute, and it is with gratitude that the following are acknowledged—

"Transactions of the Manchester Association of Engineers," 10 vols., 1906-1914. Given by the Treasurer, Mr. T. Fletcher Robinson.

"Transactions of the National Association of Cotton Manufacturers, Boston, Mass., U.S.A.," Vol. 103-104. Presented by a Member of the Association through the Secretary.

"Journal of the Huddersfield Textile Society," Vols. 1, 2, 4, and 7-22. Given by the Society.

Some of the periodicals received at the Institute are bound for better preservation, and in certain instances almost complete sets of volumes are now on the library shelves, and it is thought that some member or members may be in a position and willing to complete the sets. The following first list of volumes required is published—

"Textile Mercury," Vol. I. (1889); Vol. 14 (1896); Vols. 30 and 31 (1904); Vol. 61 (1919); Vols. 62-66 (1920-1922); "Textile Recorder," Vols. for 1883-1887, 1901-1903, and 1913-1918. "Journal of the Huddersfield Textile Society," Vols, 3, 5, and 6.

Textile Institute Diplomas—Fellowships and Associateships

The following elections to Fellowships and Associateships of the Institute have been completed since the publication in our August issue of the previous list—

FELLOWS

BARNSHAW, Charles (Bolton).
CLAPPERTON, George (Tyldesley).
COWDEN, William James Wallace (Belfast).
CURTIS, Harry Percy (Manchester).
FEARNSIDES, Frederick William (Bradford).
FOULDS, Charles Frederick (Colne).
HALL, Archibald John (Congleton).
HOWARTH, William (Bolton).
KENYON, John William (Preston).
WEBB, William Hubert (Randalstown).
WILLIAMS, Denys Roger Hesketh (Huddersfield).

ASSOCIATES

BUCKLEY, George Hervey (Nottingham).
HAINSWORTH, Sydney Beetham (Hull).
HILL, Frank (Blackburn).
METTRICK, Beaumont (Huddersfield).
MOISTER, Arthur Eric (Bradford).
MUKERJI, Bejoy Krishna (Calcutta).
NEWSHAM, William (Westhoughton).
RIDDIOUGH, Harry (Manchester).
SPRECKLEY, Reginald Stafford (Shipley).
SUTCLIFFE, Harry (Hebden Bridge).
TWOHIG, John Patrick (Bradford).
WOOD, Frederick Charles (Manchester).
WOODMAN, Herbert (London).
YOUNG, William (Carlisle).

Elected to Institute Membership

At the October meeting of the Council, the following were elected to member ship of the Institute—John E. Barbour (Linen Thread Manufacturer), c/o J. E Barbour Company, Paterson, N.J., U.S.A.; Norman Collinson (Assistant Wool Buyer), 8 Gladwin Street, Batley; J. L. Feather (Company Secretary and Director), 51 Bolling Hall Road, Bradford; J. M. Gericke (Textile Student), Technical College, Bradford; J. B. Gillett (Textile Student), South Villa, Bolton Road, Chorley; David D. Gray, junr. (Manufacturer and Director), Glenpark, Port Glasgow; Harry Hardy (Head of Textile Department, Dewsbury Technical College), Rods Mills, Morley; George Lawrie (Textile Engineer), 103 Cliftonpark Avenue, Belfast; W. Leeming (Textile Machinery Draughtsman), 62 Haywood Street, Accrington; James McClenaghan (Factory Manager), 316 Springfield Road, Belfast; Francis McEvoy (Manufacturer of Linen Damasks and Woollen, and Worsteds), Albert Street, Lurgan, Co. Armagh; Fred Morris (Textile Draughtsman and Teacher of Textile Engineering), 1 Ashbee Street, Astley Bridge, Bolton; James B. B. Morton (General Manager of Catrine Cotton Works and Bleaching Works), Ayrbank House, Catrine, Ayrshire; Joseph Parkinson (Mill Manager), 72 Chorley Old Road, Bolton; Leslie F. Pickup (Assistant Manager, Cotton Doubling and Weaving), Ibbotroyd, Wadsworth, Hebden Bridge; Fred Westhead (Cloth Salesman), c/o Wm. Westhead & Sons, Ltd., Salford Bridge Mills, Clitheroe; and James H. Yates (Textile Designer), 65 Milton Street, Nelson.

REVIEWS

Some Information about the Egyptian Cotton Market, Futures and Spot. By G. D. Economou & Co., Alexandria.

This is a very useful little handbook, containing a great deal of information about Egyptian cotton in general, and the Alexandria market in particular. It deals clearly with many of the technical matters in the cotton market of which the ordinary layman is ignorant and about which it is often very difficult to get accurate information. The book will be useful to many in the Liverpool and Manchester markets who are interested to know the differences in practice between these markets and Alexandria. A similar book dealing with each of the other principal cotton markets in this country, as well as in America and India, and on the Continent, would be very welcome. The book also contains a number of useful statistical tables with regard to the Egyptian crop since 1910, which will make it of permanent value for reference. In going through these we have noted only one slip—the acreage figures given for 1922 and 1923 are those of earlier estimates which were subsequently revised. There are also two useful maps of the Delta and Upper Egypt respectively, and interesting charts of cotton prices in Alexandria, as well as forms of the contracts commonly used in the Alexandria cotton market and an index. —J.T.

Modern Industrial Tendencies. By Sir Charles Macara. Published by Sherratt & Hughes, Manchester (253 pp. and Index; price, 5s. net).

This book of collected writings, the second that has appeared within the last twelve months, is a testimony to the vigour of Sir Charles Macara. Like its predecessor, it is mainly concerned with the question of control of the cotton trade, as a way out of its difficulties. The case is restated and the appeal for more publicity as to stocks and production of cotton yarns is made again with equal force. To the reviewer this appeal appears to be a matter to which the trade should give its closest attention. If any industry has suffered from working in the dark—and all have, and most still do—that trade is our own. The delicate adjustment of demand to supply is a matter of primary importance to Lancashire, and until there is knowledge of the facts, and not mere guessing, there cannot but be recurring dislocation. One cannot feel the same sympathy with Sir Charles Macara's advocacy of control. Let us have what the Americans call "orderly marketing" by all means; but any expedient that serves to bolster up the inflated capital of most cotton spinning firms is bad. Lancashire will never recover her markets until she can produce more cheaply; and the heavy fixed charges created during the share boom are one of the factors standing in the way of this. Sir Charles, in his spirited reply to persons who criticise the reflotation of mills, appears to miss the point. Quite obviously, it is not ordinary share capital that keeps up prices, since its return depends entirely upon the relation of turnover to costs of production, and is not itself a first charge upon the industry. What matters is the dead weight of loans and bank charges which came into being with, or as a result of, the reflotation of spinning mills. The greater part of this loan money is performing no useful function; it is dead capital, bearing no relation to the earning capacity of the industry. Control might provide a means of meeting these charges through monopolistic extortion, but any such plan would inevitably strengthen the already formidable competition from producers in India and Japan, and hasten the development of domestic production in other markets. Henry Ford, in his book "To-day and To-morrow," has some interesting things to say about dead capital. The first thing Lancashire has to do, if it is not too late, is to get rid of it. There is more point in what Sir Charles says about the effects of weak-selling upon trade. While this exists, hand-to-mouth buying is unescapable. Basis yarn prices may assist in mitigating this trouble, but there is no means of removing it except a wholesale reconstruction of the capitalisation of the industry. If basis prices are effective in providing profits, these profits must first of all be devoted to repaying loans and bank advances. If they are distributed in dividends there will be a temporary appearance of success, but the consequence will be a decline in the demand for cotton

goods. Very cheap raw cotton may help things out for a time, but it cannot be relied upon to do so for ever. The future of the trade depends upon lower prices and any control scheme that stands in the way will be disastrous. Sir Charles' book is well worth reading, but one would recommend that of Henry Ford as an antidote. —C.H.M.

Allen's Commercial Organic Analysis. Fifth Edition. Vol. III. Published by J. & A. Churchill, London.

The publishers are performing a valuable service in keeping this well-known work up to date. The volume under review deals with Hydrocarbons, Bitumens, Naphthalene and its derivatives, Anthracene and its allies, Phenols, Aromatic Acids, Gallic Acids and derivatives, Phthalic Acids and Phthaleins, and Modern Explosives. Under "Phenols" is included a valuable section on disinfectants, while under "Phthaleins" is a modern account of indicators. In order to keep the size of the volume within bounds, the section on Benzol and its homologues has been transferred to another volume, along with dyestuffs. It is unfortunate that this has been deemed necessary, as one would naturally look for Benzol amongst the other aromatic hydrocarbons. As it stands, however, the volume is a mine of information on the properties and methods of analysis of the substances concerned, and should be in every commercial organic laboratory. —R.G.

Hosiery Yarns and Fabrics. By John Chamberlain, Leicester. Published by J. W. Hemmings and Capey.

Students of the knitting industry will welcome Volume II. of a series of text books being prepared for the Textile Trades Advisory Committee of the City of Leicester Colleges of Technology and Art. The fact that the author of this work was joint author of several books on the subject of knitting, now unobtainable, will commend it to those interested in the industry. The book opens with a chapter on raw materials consisting of natural and artificial products, and the essential qualifications of those products for the manufacture of knitting yarns. Twelve pages are allotted to sources of supply, classification, microscopical examination, characteristics, and composition of animal fibres. Seven pages are devoted to vegetable fibres, and three pages to artificial fibres. The hollow artificial fibre referred to is known as "Celta," and produces a fabric easily distinguished by its softness of handle. Chapter II. classifies the yarns manufactured from the various fibres according to "count," "fibrous composition," "spinning and doubling operations," "finishing, bleaching, and dyeing"; furnishing tables of the numerous single fibred yarns under the various headings of wool, cotton, silk, &c. Whilst the author acknowledges that spinning is a subject to itself, the many processes through which the fibres must pass in their conversion into yarns are treated in a manner likely to tempt the student into securing a deeper knowledge of the subject. The blending of fibres and yarns to produce mixtures and fancies is also included. Yarn testing is then dealt with and covers "recognition of fibres," "testing for counts," "twist," "condition," "strength and extensibility," and giving interesting examples of actual tests and results. Chapter IV. on yarn winding rightly emphasises the importance of this operation, dealing with lubricants, knot-tying, &c., and providing twelve sectional diagrams of machines used in the winding of every conceivable type of yarn for knitting. A diagram is also given of a back-winding machine for the recovery of yarn from imperfect fabric, and a warping mill. Chapter V. opens with a brief description of the production of a woven fabric by means of the "intersection system" and of the "twisting system," as adopted in the manufacture of lace. The diagram of the twisted lace fabric is better known as bobbin net and is made on a two-tier carriage machine of the rolling locker or double locker type. In describing the "looping system" on which knitted fabrics are constructed, the writer gives a clear definition of the weft and warp fabrics, then sub-divides the three primary stitches used in weft-knitting. The arrangements of these stitches in the first diagram is very effective and is followed in this chapter by nine really lucid diagrams, which include binding off, linking, wale-narrowing, roll-welt, racked-welt, plain-plated, and twisted loops. Chapter VI. gives a list of twelve fancy stitches, most of which are admirably illustrated,

and followed by over 50 designs on flat and purl machines. Chapter VII., on warp-knitted stitches, is of special interest. The distinction in the structure as compared with weft stitches is clearly demonstrated, and includes a list classifying close warp fabrics in comparison with weft knitted fabrics. Commencing with the simplest lap producible, the writer deals with the drafting of designs, showing diagrams and interpretations of the various laps used in the making of several well known warp fabrics. The making up of knitted fabrics into the finished article requires machines specially adapted to this branch of the industry. The closing chapter mainly deals with the numerous stitches employed in joining up various types of knitted fabric. Questions set at the close of each chapter will enable the student to test his knowledge of each subject. The book will be found very helpful. —G.H.B.

GENERAL ITEMS AND REPORTS

Standardisation in the Textile Trade

Mr. A. M. Samuel, M.P., Parliamentary Secretary to the Department of Overseas Trade, gave an address on "Some Aspects of Overseas Trade" before the Bradford Textile Society on Monday, 1st November; Mr. Arthur Hitt, President of the Society, occupying the chair. Mr. Samuel referred to the danger of a shortage of raw natural silk, and appealed to his hearers to do what they could to foster production within the Empire. As result of the efforts of the Silk Committee at the Imperial Institute (which was now linked up with the Department of Overseas Trade), Cyprus, which was under British rule, was producing excellent raw silk, the cocoons being reeled there instead of dealt with by filature at Marseilles, as had hitherto been the case. Experiments had proved that raw silk could be grown in several parts of India and in Irak, Jamaica, Kenya, Rhodesia, and Hong-Kong. Just as the production of rubber had brought great wealth to the British Empire, so could the production of raw silk be fostered within our Dominions to the profit of all. There was every prospect of a world shortage of supplies of raw and waste silk, and unless that state of affairs was remedied it would have a serious result on the British silk industry, especially as America would continue to bid for the bulk of the available supplies, particularly those of higher quality. He did not think that artificial silk was likely to affect the demand for real silk goods, except possibly the lower grades. Another question he wished to bring before their notice was that of standardisation. Standardisation might not seem to be applicable to Bradford, because changes of fashion in dress were desirable as a source of profit. Nevertheless, the National Association of Outfitters was already pursuing a policy of standardisation of sizes in men's underwear, and in the ladies' shoe trade the policy was being discussed. It had often been stated that we tried to force on our foreign customers the sizes and varieties we wished to sell, rather than those they wished to buy. He thought the accusation was, in many cases, unfounded, and the fact was that the choice we gave to them was unnecessarily diverse. The tendency to standardise articles was growing in other countries, and we must keep abreast of such developments.

Mr. F. Hopkinson, in the course of the discussion, said he did not see how the standardisation of Bradford or Manchester products would help in obtaining trade in overseas markets, because the demand of the world would always be for novelties, and other countries were producing them.

Mr. Samuel said he did not think the textile trade provided a good example of an industry that would benefit from standardisation. Standardisation for the home trade, however, would reduce overhead charges and enable products to be sold more cheaply, thus facilitating the production of greater variety for export. Other countries were showing novelties abroad and reducing the variety of patterns at home.

Mr. John Emsley said in the past Bradford had made a great mistake in telling foreigners either to take the goods or leave them. When they refused to make a fresh pattern for a customer, someone else stepped in and took the order. Standardisation was all right so long as there was a certain number of people prepared to dress all alike, but in England variety was wanted. They were catering not only for the Bradford market, but for every market in the world,

English and Continental Systems of Worsted Drawing and Spinning

Mr. S. Kershaw, of the Bradford Technical College, addressed a meeting of the Huddersfield Textile Society at the Technical College, Huddersfield, on Monday, 8th November, on the subject of "Recent Investigations in Worsted Drawing and Spinning." An investigation carried out recently, said Mr. Kershaw, had shown that drawing might be considered the most important of the sequence of operations from the top to the finished fabric. Yarns and cloths drawn by the Continental method had valuable properties not possessed by materials drawn by the open or cone methods; the Continental method in all instances produced stronger and fuller yarns and cloths. Probably the greatest step forward that the worsted industry of Yorkshire could make would be to put down more machinery for working short fine wools into yarns suitable for soft-handling dress goods and hosiery fabrics. The benefits to be derived by worsted spinners if yarns were manufactured in this country on the Continental system would be that cheaper raw materials could be used to produce equally good if not superior yarns to those obtained by existing methods. By the use of the Heilmann comb, porcupine drawing, and mule spinning, very short wools could be made into worsted yarns. Yarns produced on these machines possessed excellent handling properties suitable for hosieries. For certain types of wool the Continental system was the only system for conversion into worsted yarns. From the fabric point of view the Continental system was superior to the English system. Openness of fibre arrangement permitted better manipulation in dyeing and finishing. The Continental system was recommended as a supporter and not as a supplanter to the English method. If there were more porcupine drawing sets followed by either the mule or the Continental ring frame, many wools difficult to process on open and cone machines would be re-directed, and better and more easily manipulated. While not claiming that the Continental ring frame was as good as the mule for spinning fine counts, yet splendid results were obtained in thicker yarns for hosiery purposes. The simplicity of the machine assured it a place in the industry, and when it was considered that wool two inches in length could be controlled and made into level yarns, its usefulness needed no emphasis. The spirit of investigation was still needed to settle many problems in worsted yarn manufacture. While making the most of existing processes, we should not be afraid of experimenting, as many secrets might be revealed which were at present unknown.

Replying to a vote of thanks, Mr. Kershaw said they were reaching a point where many things might happen to the Huddersfield trade. Artificial silk was coming into Bradford and being combed into tops, sometimes alone, and sometimes combined with wool. Yarns were being produced containing 50% of silk and 50% of wool. The pieces produced were sent to the dyer, who returned from one good piece about twenty shades of coloured mixture cloths, the silk taking one colour and the wool another. Huddersfield was noted for its coloured trade, but it might so happen that it might be supplanted by this silk and wool mixture.

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PROCEEDINGS

Luncheon Meeting of the United States Members of the Textile Institute, Copley Plaza Hotel, Boston, Mass., 13th October, 1926.

A luncheon meeting of members in the United States of the Textile Institute, and the first general meeting of these members, was held on 13th October at the Copley Plaza Hotel, Boston, pursuant to the call of a "Committee of Arrangements" made up of members in and near Boston, of which Franklin W. Hobbs was Chairman, this meeting having been held in Boston, 17th September. Those in attendance were as follows—Franklin W. Hobbs, Boston; Charles H. Clark, Boston; Edmund E. Blake, Biddeford; James T. Broadbent, New York; R. H. Brown, Boston; A. G. Denis, Webster; Daniel E. Douty, New York; George L. Gilmore, Somerville; G. Van Tromp Govier, Decatur; F. J. Hoxie, Boston; Edwin H. Marble, Worcester; C. E. Mead, Boston; Brackett Parsons, Boston; Frank W. Reynolds, Boston; Charles W. Schoffstall, Washington; J. Tattersall, Boston; A. M. Tenney, New York; E. D. Walen, Lawrence; Harold D. W. Smith, New York; and Mr. Weston Howland, Assistant Treasurer of the Warwick Mills, Centerville, R.I. To make the most of the brief time until the convening of the first session of the convention of the National Association of Cotton Manufacturers, to which Institute members had been invited, the acting Chairman asked the acting Secretary—Mr. C. H. Clark—to make a report of events that had led up to this meeting. In the course of this report Mr. Clark referred to the letter-vote of members reported at the meeting, 5th August, giving the views of 22 members on the subject, three of whom opposed any new organisation, five favoured a branch of the Textile Institute in this country, five favoured some separate organisation for the promotion of research work, and nine stated that they would abide by a majority decision. Mr. Clark stated that correspondence and personal interviews with members since then had altered the vote of these 22 members as follows—two opposed to any new organisation, sixteen favoured a branch of the Textile Institute, one favoured a separate organisation, and three were willing to abide by a majority decision. Of 29 members who had expressed an opinion either by mail or in person, 26 were either in favour of a branch of the Institute in this country, or would abide by majority decision on the subject. Expressing his personal views on the subject of organisation, Mr. Clark stated that his correspondence and talks with members had impressed him with the fact that they represented a little group which had been brought together automatically by their interest in research as expressed by their membership of the Textile Institute, largely for the purpose of obtaining copies of the *Journal of the Textile Institute*, with its reports of British textile work. The leading textile associations in the United States from time to time had had Research Committees, but at present these were either non-existent or inactive. None

would dispute the advantage to the industry of the future of research work, and he felt that some one body having the development of research work as its chief objective would prove of great value to the industry, and that the members of the Textile Institute in this country were the logical *nucleus* of such a body. Its present membership would give such an organisation contact with every important textile association and present source of textile research work in this country, and also connection with the parent body in England, which might prove of mutual advantage. He did not think it mattered much at the start whether the members came together as a section of the Textile Institute or as a separate organisation, but hoped that some form of organisation could be given a trial, feeling certain the membership could be largely increased and that the organisation could be made a powerful factor in stimulating interest in textile research work.

The Chairman agreed in large part with what Mr. Clark had said, and felt that there were important opportunities for an organisation composed of the Textile Institute membership in this country, but he was not certain as to the best form of organisation. He read a letter addressed to him by President Calvin Rice, of the American Society of Mechanical Engineers, of which he is a member. President Rice's letter said that he had heard of the movement for organisation of a branch of the Textile Institute in this country, and expressed the hope that its membership would find what it needed in the textile section of the A.S.M.E. Chairman Hobbs then asked for a general expression of opinion from those present as to the form of organisation and the function of the body.

James T. Broadbent (New York) felt that it would be unfortunate if those who represented such an important organisation could not get together and find a real service to perform for the industry. He felt that the form of the organisation was of the least importance. He thought that Mr. Athey's letter of 23rd September to Mr. Clark ought to be accepted at its face value, and that organisation of a branch or section might be delayed until there was a larger membership. In the meantime it would be well to learn what obligations to the parent organisation were involved by the organisation of a section. He thought it would be sufficient at present to get together once or twice a year; that if a title was needed the group might be called the Textile Institute Club.

E. H. Marble (Worcester) could see no possible conflict between the membership of the Textile Institute in this country organised as a section or a club and the textile section of the A.S.M.E., or with any other existing textile organisation. He believed that there was a big field for such an organisation, stating that among its functions could be the development of an international nomenclature for textiles.

F. W. Reynolds (Boston) stated that he liked the club idea, and suggested that it might be called a Textile Research Club.

E. E. Blake (Biddeford) also approved a club idea, and suggested the title "American Members of the Textile Institute."

D. E. Douty (New York) stated that he knew of no Textile Association that is now giving serious and constant attention to the development of research work, and that in this group of men who had been brought together by this subject it ought to be possible to perform a real service for the industry. There should be no duplication of the work of other associations, and he believed that this could be easily avoided. He also believed that the form of the organisation was of less importance than the act of organising.

J. T. Broadbent then moved, and Edwin H. Marble seconded, the organisation of the Textile Institute Club, the Secretary being instructed to learn whether as a section of the Textile Institute there would be any obligations to be assumed. Upon being put by Chairman Hobbs, the motion was carried unanimously.

Chairman Hobbs then presented on behalf of the "Committee of Arrangements" for this meeting the following suggested committee and officers of the

new organisation, stating that the names were selected with the idea of giving contacts with all of the leading textile associations as far as the present membership made possible—George L. Gilmore, Chairman; James T. Broadbent, Vice-chairman; Charles H. Clark, Secretary-Treasurer; Franklin W. Hobbs, Edwin H. Marble, E. D. Walen, A. M. Tenney, Brackett Parsons, D. E. Douty.

E. E. Blake moved that the Secretary be instructed to cast one ballot for the ticket, and that the committee members and officers hold office until succeeded. This being properly seconded, the motion was carried unanimously, and Secretary Clark cast the ballot as instructed.

Acting Chairman F. W. Hobbs then turned the meeting over to Chairman George L. Gilmore, and the latter, after thanking the members present for the honour conferred upon him and promising to perform the functions of his office to the best of his ability, expressed regret that Franklin W. Hobbs had felt it impossible to accept the chairmanship. He then suggested that, for the purpose of covering correspondence and other secretarial expenses, an assessment of 5 dollars be made on each member of the club, this to cover the luncheon also. Upon being moved and seconded, the motion was carried unanimously. The meeting was then formally adjourned subject to call of the committee.

In the informal discussion that followed the hope was expressed by many that the next meeting could be held at the time of the next spring convention of the National Association of Cotton Manufacturers, if not before, and that it might be possible to hold group meetings in Boston and New York, in the interim, of members in and near those centres.

Yorkshire Section

Joint Meeting with the Halifax Textile Society, 20th October, 1926;
G. W. Haigh, Esq., in the chair.

TOPMAKING—DO ENGLISH METHODS PAY?

By R. G. Bailey, F.T.I.

With regard to topmaking and the question, "Do English methods pay?" I have no doubt that some of you have already answered that question in your own minds. You have been thinking of a few of the large topmaking concerns of Bradford and district—firms which from small beginnings have grown into marvellous organisations with world-wide reputations. My remarks this evening, however, are not concerned with the profits of individual firms. It is from a national point of view—not that of the individual—that I wish to consider the matter. I want to consider whether our methods of topmaking are the best for the country. Are they sound methods, are they economical, or is the present procedure wasteful from a national point of view? Much of what I wish to say relates to the economical use of raw materials. When I speak of the waste of materials I do not mean actual waste of wool in topmaking, or waste as known by the trade in the spinning and weaving processes, but if for one reason or another in any finished fabric—be it woven fabrics or hosiery—a type of wool is used better than that necessary to produce the finished article, then national waste has taken place.

The subject of topmaking cannot adequately be dealt with in half an hour's talk, and it will be impossible to consider more than one or two special features. I want first very briefly to consider present methods; then a few of the disadvantages which are inherited from present procedures by all engaged in the later operations, that is, spinning, weaving, as well as dyeing and finishing; and finally to submit some suggestions which, if carried out, would obviate, in my opinion, many of the present difficulties. Specialisation has become increasingly prevalent in the wool textile trade of England, especially in the

worsted section. There are still many spinners who make the bulk of the tops they use, and a few firms which buy the raw wool and put it through all processes to the finished fabric, but the greater part of the tops made in this country to-day are produced under the control of topmakers, whose function ceases when they sell the tops to a spinner, to a dealer, or to an export merchant. Owing to the tremendous variety of wool types, topmakers are divided into different categories, the chief of which are merino, crossbred, and English. In some cases, particularly with the larger firms, a firm may make all three types, but this is the exception rather than the rule.

Briefly stated, it is the vocation of a topmaker to buy wools as cheaply as possible, either in the primary markets of the world—Australia, New Zealand, the Cape, South America—or in London or locally; to sort them as to suitability for the making of his standard range of tops, and to blend them so as to produce tops as nearly as possible of the same quality as previous lots. If a Bradford wool buyer were sent to London with a limit of, say, 4s., for 64's warp tops, then generally, if the wool suited his requirements regarding length and quality, it would not matter whether it came from Melbourne or Adelaide. Spinning properties are only a secondary consideration to fineness of fibre and length, and the limit at which he has to purchase. Some topmakers never use wools from South America or wools from the Cape, but confine their blends to, say, Australian or New Zealand wools. Others never purchase "scoureds," and quite a number refuse to use "skin wools," but even the topmakers making the very best tops invariably blend wool from different parts of Australia to make their standard. With very few exceptions tops made by topmakers in the West Riding are all of a blended nature.

There are two main objects in blending—first, to obtain certain effects in the yarn and the cloth; second, to cheapen the top. With regard to the first, success can only be assured when the blender knows the spinning and felting properties of his wools. With regard to the second, when blending is undertaken to cheapen the top, the faults of working to a price are manifest. A good top might be made one year from a good blend. The following season the price factor alone might rule out that particular blend. There is, of course, the striking example of Cape wool. Cape wool was primarily used as a cheapening element, whilst now it is relatively dearer than Australian. Even the largest firms in Bradford, if Melbourne and Adelaide wools come in at the same time, might make a fifty-fifty blend. They might make a 100% Victoria but seldom would make a 100% Adelaide; that is to say, on one occasion an article composed wholly of wools from Victoria is delivered, whilst on another occasion the top may be a blend of Adelaide and Melbourne wools. Both deliveries would be sent as equal and against a so-called standard.

Spinners naturally are aware that practically all the tops they purchase are made from blended wools, and immediately the spinning properties of any top they receive prove inferior to the spinning properties of a previous delivery of the same quality, a complaint is made. The spinner, probably having heard many years ago that Cape wools and wools from South America are inferior to those from Australia, immediately concludes that these wools have been mixed in by the topmaker. Many years ago it was an undoubted fact that Cape wools and wools from South America were inferior in almost all their properties to the Australian products, but during the last twenty years Cape wools, and certain types of South American wools, have improved almost beyond recognition, but, as in some instances, the spinner in the meantime has had no opportunity of getting to know the improved properties of these wools, he still retains his old prejudice against them. The wools of South Africa are being appreciated more to-day by Bradford topmakers and spinners than ever before, but even to-day I am satisfied that many firms have not given Cape Wools a fair chance. For hosiery fabrics, Capes are being used in increasing quantities, and

one cannot help but point to the big weight of short Cape wools which are being spun on the Continent and sold to Leicester hosiery manufacturers. This also applies to Chubut wools of South America, nearly all of which are shipped to the Continent for spinning into hosiery yarns. Apart from Punta wools, few, if any, topmakers in the West Riding admit that they use South American wools, but nevertheless many topmakers buy South American wools for topmaking purposes, and at a conservative estimate more than 50% of wool used to make 46's and lower prepared tops is of South American origin.

At the present time the topmaker selects from various countries wools with equal blending qualities, such as length, fineness, and character, and he must be able to repeat standard deliveries at all times, this being one of the most vital points of all. I have never forgotten having it drilled into me at school that the composition of a chemical compound was constant. Topmakers make standard tops, but however good their intentions may be, the deliveries obtained at different times vary. In a chemical compound the components are always the same, but the finest and most careful topmaker would never claim that his tops—one delivery compared with another—were absolutely identical. In sorting, for instance, personal judgment has to be used, and therefore differences are bound to result.

If all wool were alike, if there were no such things as difference in breed, in fineness of fibre, in length, strength, and handle, &c., then the economical manufacturing of wool textiles would be almost entirely a question of economically running the machinery. As, however, there are a thousand different kinds of wool, one factor which ranks at least with equal importance to that of the economical running of machinery is the correct choice of the raw material for the effect and article required. Knowledge of topmaking, spinning, and weaving is further advanced on the mechanical side than on the material side. Commission wool combers in the West Riding of Yorkshire have tried unceasingly to perfect the art of woolcombing, at least so far as the usual English systems are concerned, and large sums of money have been spent in research work, but commission combers are only concerned with the machinery side of topmaking. No matter how much research is undertaken by the comber, it can only be on the manipulative side—the machinery side of topmaking. At the other end of the trade one has the cloth finisher, and I think it can safely be said that probably in no other country in the world has so much experimental work been undertaken with regard to the finishing of textile products as in this country.

Although it is admitted that the weaving loom is one of the most unscientific machines used in the textile industry, people have tried for generations to im prove it in order to make a more perfect cloth. It must be realised that the perfect cloth can only be obtained when the manufacturer gets the perfect material for the ultimate fabric in view. Machinery improvements certainly are essential, and in the textile trade there appears to be much scope still for inventive genius, but the most perfect machines in the world, managed by the most experienced workpeople, will not prove successful unless the correct material is being used. I contend that to-day faults in the finished article are not infrequently due to the wrong selection of the raw materials rather than to bad workmanship in the processing of the material.

It must be admitted that certain wools are more useful than others for obtaining certain effects in cloths, but a topmaker could not be expected to know much, if anything, about that. He has no chance of getting to know, and this, I think you will agree, also applies to the spinner to much the same extent. Some spinners, of course, do occasionally see the cloths into which their yarns have gone, but, generally speaking, I think that when a spinner receives an invitation from his customer to inspect the fabrics being made from his yarns, the invitation creates a somewhat nervous feeling, because more often than not such invitation is only made in order to put before the spinner some complaint.

It has been said that manufacturers do not know a great deal about classes of wools other than those which they themselves use. In the case of worsted manufacturers the majority are not in a position to know even the origin of the wools they are using. It is of vital importance that manufacturers should get to know the actual properties of various wools and the uses to which they are most fitted, but this is impossible so long as spinners are compelled to use blended tops, and manufacturers, as a net result, receive yarns containing a conglomeration of greasy, scoured, and skin wools from Australia, the Cape, and South America. I think you will realise that as the properties of wools do vary, it is possible to mix together wools of different types which may be working against each other, if not in the combing or even the spinning, perhaps in the finishing operations. The foundation of the West Riding wool textile industry was laid by manufacturers using British wools grown upon the neighbouring hills, and they learned thoroughly the properties of the various British grown wools. The West Riding textile trade would never have assumed its present proportions but for the wools of our Colonies, but I am confident of this, that the present generation do not know as much regarding the properties of Colonial wools as their forefathers did regarding English wools. The trade has standardised, but there is one thing which standardisation has done in Bradford; the trade has knocked itself out of the running for producing yarns and fabrics such as those from France and Germany. If you make a point of using a uniform fibre and not mixing it for certain classes of fabrics, you will get a better result and a result which cannot be obtained by mixing. If we are to make such fabrics as the French make it will be necessary to go right back to the sheep, buy the wools, and, without blending, carry them through all the processes to the finished article. Our Continental rivals have done this, and have evolved a type of machinery suitable to the requirements of the wools which they use. Everyone admits that care must be taken in the choice of materials, but seldom, if ever, is it possible to get any further. Under present procedure it appears impossible to get to know with absolute certainty the type of material best suited for a particular fabric. I contend, however, that just as there is one exact place on the violin string on which the finger must be placed in order to produce a particular tone, so there is a particular raw material which must be used to attain any specific result. For instance, who in England to-day could, with conviction, tell us what wools to use for certain cloths, or which cloths to make from various wools? Certainly not the wool merchant or top maker.

The woollen designer—and in many cases the worsted designer—to be fully competent, must be a materials expert. In woollen cloth designing, even more so than in worsted manufacturing, the raw materials must be carefully selected, always bearing in mind the finished effect required. I remember, as a student at the Bradford Technical College, repeatedly being told that a woollen fabric was more or less made in the finishing. This is undoubtedly true. In woollen cloth designing the milling and felting properties of wools have to be specially considered, and it is essential that the finisher should know the wools being used. In England woollen manufacturers enjoy a special advantage over worsted manufacturers in that they select their raw material, make their own blend, keeping a record of quantities and qualities and values right through the processes.

So far I have tried to show some of the disadvantages under which spinners and manufacturers in this country are compelled to work. Disadvantages due to the fact that they are more or less compelled to use raw material the origin of which is unknown to them. Yet it is an admitted fact that wools of the same quality but grown in different districts vary considerably in their spinning and manufacturing properties. A change in fashion is probably more serious to the West Riding textile trade than to the industry in France and Germany, because in this country the designer is less familiar with the special properties of certain

wools, and he therefore takes more time in achieving the desired result. A manufacturer may get a yarn which produces the cloth required, but not at an economical price. If we are to regain our premier position in the world's markets, then much greater thought will have to be given to the utilisation of the correct material to make the best article at the lowest price consistent with quality and good workmanship.

There are many fallacies regarding blending, and these are bound to continue until research is undertaken to determine the properties of various wools. This can only be carried out by a very much closer co-operation between topmaker and spinner, weaver and finisher. Fallacies regarding blending will remain so long as topmakers continue to supply standard tops the wools of which are of unknown origin—at least to subsequent users. It is certain that our Continental competitors appreciate to a fine point the various properties of the many types of wools. The French and Germans, for example, appear to specialise individually in certain types of yarn, and take full advantage of the divergent properties offered to them in the raw material. In Germany, where tops are made by topmakers and combed by a commission woolcomber, blending does not take place. Montevideo wools, for example, are not mixed with Australian or with any other wool. Even different types of South American wools are kept quite separate in the combing. Sorting is carried out under the control of the commission comber, and he is in a position to give a certificate of origin with regard to the wools being used—a guarantee of the raw material employed. I maintain that this is the only scientific way of topmaking from a material point of view, because under a procedure of this kind the spinner is in a position to know exactly what he is using, and this information can be passed on to the manufacturer whether of pieces or hosiery.

Foreign competition is on the increase. New countries buy the latest machinery. They may be handicapped for a time by the necessity of employing unskilled and semi-skilled workpeople, but very soon their workers become efficient and competition between this country and others naturally will become still more keen. England possesses the lead by reason of our well-trained operatives and the inborn skill of our workers, and this advantage must not be frittered away by using less up-to-date machinery, or, what is equally important, a disinclination to adopt new methods.

In any industry there are three partners—capital, management, and labour—and I believe at the present time that management is the most important factor of the lot. It is management which is the bedrock of more efficient production. It is not sufficient for the management just to know their own individual line, but what goes before and what follows, and in the industry as conducted in England at the present time there is, in my humble opinion, much scope for improved methods. I have tried to show how closer co-operation might be brought about between various sections of the industry—something which is essential from a national point of view, and I am firmly convinced that with this co-operation and a better understanding of the requirements of users, this great industry, of which we are all so proud, could yet lead the world.

London Section

Discussion Meeting at the Institute's Rooms, 38 Bloomsbury Square, W.C.1, 10th November 1926. Chairman, Mr. E. Wigglesworth.

DECORATIVE SILKS—THE DEVELOPMENT OF DESIGN

The Chairman, introducing the Lecturer, explained that Mr. Woodman was a member of the firm of Warner & Sons, of Newgate Street, which firm had the reputation for manufacturing the finest decorative and furnishing fabrics in this country.

Mr. Woodman said—I shall attempt to give a brief sketch of the principal styles or periods in furnishing silks and similar fabrics. As so many of the famous designs of the 14th–19th centuries are being reproduced in modern fabrics it is only natural that a greater interest is being taken in their origin than at any previous time. The original artists of these period designs could never have imagined how, in the 20th century, their works would be reproduced in such vast quantities, chiefly in fabrics which are within the purchasing range of the average householder. To follow the development of these popular styles successfully, it is helpful to trace some of the great influences which have affected them, so perhaps a few words on the ancient silks will not be out of place. I might say that it is impossible to draw fine dividing lines between the various periods; there is nearly always what one might call a "merging" style where we find the old and new influence both present. According to Chinese tradition elaborate silks were being woven many centuries before the Christian era but no pre-Christian examples have been preserved. I believe the oldest in existence are some pieces found in a Chinese-Turkestan tomb of between the 1st and the 3rd Centuries A.D. They display the most remarkable animal designs drawn in a free style and not far removed from Chinese designs woven centuries later. The secret of sericulture was carefully guarded by the Chinese until the 3rd Century A.D., when Khotan, Japan, and India are supposed to have discovered it; not until the year 552 A.D. did the people of the Near East solve the mystery, when two monks smuggled silkworm eggs into Constantinople, where silk and linen fabrics were then being woven. We have ample proof that these countries had already acquired a high standard of decorative art by reference to ancient writers and Assyrian bas-reliefs, &c. These early silk and linen designs were chiefly lozenge or dice arrangements. Then developed designs of circular panels enclosing such figures as winged monsters, chariot races and animals back to back, each country having peculiar motifs of its own. We have several of these early fabrics dating from the 6th century onwards in the Victoria and Albert Museum, chiefly found in Egyptian tombs. The colours on many are still good, which speaks well of the dyes they used; several colours of weft were used often on a bright cherry, green, or gold ground. These circular panels were used for centuries but the detail drawing was gradually becoming more advanced. The first great change took place after the 9th century, when the Arabians conquered Persia, Syria, and the surrounding countries; they also moved westwards along the north of Africa and into Spain where they introduced silk weaving. Arabian influence can be traced in the art of all these countries after this date, and the early Spanish designs were purely Arabian. The silks of Constantinople were very popular at that time and during the 10th century designers introduced what is known as the "ogee" basis into their fabrics, a foundation on which many famous Italian designs were built. During the 12th century an important development took place when the Norman King of Sicily conquered Athens and brought a colony of Greek weavers to Palermo where they taught the Sicilians the art. It was not long before it was an important industry; the early designs were chiefly of Saracenic or Arabian character, but they developed a style of their own. The next step was the introduction of the industry into Italy near the end

of the 12th century and this was the beginning of a great age in textile achievement both from the artistic and the technical point of view. Lucca was the first and leading town during the 13th and 14th centuries and between these dates a complete change took place in the style of design. The circular panels and other symmetrical forms which had been so prominent for centuries were completely dropped and a freer style emerged. All the new designs suggested great activity; animals leaping, birds in full flight and trees bending give us some idea of the lively conditions of the industry. The draw loom was improved and textures became richer; metal threads were now being used. Venice, Florence, and Genoa gradually took the lead from Lucca and from these cities came the wonderful velvet brocades which are certainly among the richest of all works of art. Figured velvets were being woven during the 14th century and the early designs were similar to those of the damasks or brocades, but the artist found that the animal and other forms such as sun rays, &c., were not suitable for these new and luxurious fabrics. This brings us to the late Gothic style, probably the most majestic of all, the principal features being the bold treatment of the plant form—such as the vine or pomegranate motifs—and the wide bands often on the ogee basis. Italy remained the leading silk country during the 16th century, but the French were now making rapid strides and gradually taking the lead. In the Italian 16th century fabrics we find the pineapple introduced, also flower vases and generally more detail which gave a different distribution of figure. It is largely the well-balanced distribution of the figure in the Italian designs of the 16th and 17th centuries which makes them so suitable for modern fabrics. The later designs included imitations of the prevailing French styles which had become so popular.

The industry was really introduced into France during the latter part of the 15th century and followed closely on the Italian lines for a time, but during the 17th and 18th centuries the French produced original styles and gorgeous fabrics equal in workmanship to the famous Italian textures. The nature of the designs and colourings was much brighter and more elaborate than anything seen before. [*Louis XIII., XIV., XV., and XVI. styles were then described and samples shown.*] With the French Revolution came a distinct change in style; no ribbons, garlands, and sentimental love emblems were seen as in the previous modes, but a more severe type of ornament, arranged on symbolical lines, at the same time being majestic. After the downfall of Napoleon we find a gradual return to naturalistic drawings and colourings, but they never attained the same standard as the pre-Revolution styles. In the latter part of the 19th century came the Art Nouveau movement, a mode which has often been described as the "weird and fantastic"; orthodox traditions being completely disregarded.

Decorative silks were not being woven in England in large quantities before the arrival of the Hugenots from France near the end of the 17th century, but early in the 18th century, silk weaving became a most prosperous industry. Elaborate brocades and velvets were produced very similar in every respect to those of the Continent. During the century, however, English styles became distinct from the French and they are still very popular in all countries. The famous furniture and interior styles of Chippendale, Sheraton, and Adams had a great influence on the textiles, and we find a gradual change from the bold designs of the Early Georgian to the more delicate ones of the Adams' decoration. Just as the 18th century is referred to as the "Golden Age" in British decoration, so the 19th is just the reverse and we find that very few things of this period have much artistic merit. Early in the 19th century Jacquard and power looms were gradually taking a firm hold and designs were being produced in increased numbers but of inferior quality. The high class trade had almost vanished by the middle of the century and then came a revival largely inspired by the "Arts and Crafts" movement of which William Morris, Burne-Jones, and Walter Crane were leaders. A new interest was created in all forms of decorative art, and

when referring to the particular branch of velvets and brocades it is difficult to leave out the name of the late Mr. Benjamin Warner, whose energy and skill gradually brought the craft to life again. The modern style of decoration as we saw it at the International Exhibition in Paris last year caused a great amount of interest in the furnishing world for all the exhibits were original in design. I have a few drawings which will give you a better idea of the "New Style" than any remarks of mine. Having one or two designs of my own in the Exhibition I am not the proper person to express an opinion on the artistic merits of the various nationalities. I am certain of this, however, that so far as the textures or qualities were concerned the British exhibits were equal to anything on view. Whether there will be a great demand for the New Style remains to be seen, but at present the old designs to which I have referred are being produced in huge quantities on all types of fabrics. Many we see are crossbreds, part of an old design being used and modified to make a cloth suitable for the upholsterer who requires a design which will cut up without waste. I will close with a few remarks on the respective merits of power and hand loom production. There is no doubt that the power loom is making giant strides and producing a wonderful range of fabrics, such as damasks, tissues, and brocatelles, but there will always be a need for the hand loom when producing the richest class of goods. The power loom has advantages in allowing the designer to obtain many fancy effects through being able to lift a greater number of individual threads than the hand loom worker can lift, but against this must be set off the exquisite feel which is obtained by the hand loom weavers' personal control of every motion on the loom.

Discussion

Mr. E. Wigglesworth—From the samples that Mr. Woodman has shown this evening, it appears to me that even to-day we still have designers in England who can equal the work of those artists who produced fabrics when design had reached its highest standard. I would like to ask Mr. Woodman if in his opinion sufficient attention is now being paid to the training of designers in period work. The hand loom, of which most of the fabrics shown here to-night are products, still seems to be a necessity where fine work is demanded. To-day in Ireland weavers find that for the finest grades of ladies' handkerchiefs there is nothing like the hand loom. Is it possible to secure any training in hand loom weaving to-day, and do the big distributors give any encouragement to hand-woven fabrics ?

Capt. S. E. J. Brady—It is very satisfying to see such fabrics as are displayed to-night and to know that they have been woven in an English factory. Were these cloths (pointing to a Louis Seize tissue) woven in 28 or 50 inch widths ?

Mr. Woodman—These are all 50 inch cloths. The design repeats four times across the width.

Capt. Brady—Can you manufacture these on the power loom ?

Mr. Woodman—Yes ; but there is a limit to the number of ends to the inch we can use successfully on the power loom. To reproduce that design on the power loom we should use less ends per inch, but a thicker warp.

Mr. E. Wigglesworth—What is the difference in cost ?

Mr. Woodman—Using less ends per inch I should imagine that this design (again referring to the Louis Seize) could be reproduced on the power loom at about 40% less than the hand loom cost. With the hand loom the weaver must study his fabric very carefully—the value drops immediately with any flaw. (Replying to Mr. Wigglesworth, Mr. Woodman said)—Conditions are very different to-day from what they were at the time many of these famous designs were produced; in the old days members of the aristocracy were the only people who possessed decorative fabrics. Weaving was not a factory craft. The designer could concentrate on productions without much regard to cost and size, &c. To-day, although there is more demand for originality than ever, the manufacturer and designer usually have to consider the usefulness of fabric and cost of

production, which means that the finest designs, from a purely artistic point of view, are not always the best sellers. It must be remembered that many fabrics of this type are to be used in the upholstery trade, and in consequence one must always bear in mind the question of "cutting-up."

Capt. Brady—All the designs you are showing are floral or figured. Is not the modern tendency towards geometric design ?

Mr. Woodman—We do produce a few geometrical designs.

Capt. Brady—With small repeat ?

Mr. Woodman—Yes.

Mr. D. Anthony-Langsdale—If we were to get away from the floral or natural type of design in this class of fabric, it would be very interesting to see what would replace it.

Mr. A. B. Shearer—I would like to call attention to the effect that religion has had upon design. Mohammed taught his followers that it was impious to copy the designs of the Almighty and as a result the Arabic and Saracen designers produced patterns in geometric forms. The influence of this can be noted in the later Gothic type. There is a good deal of misunderstanding as to the capabilities of the power loom. The power loom can do anything which the hand loom can do, and a great deal more. The hand loom cannot lift the number of ends that the power loom can lift—I know several power looms using 5,000 hooks; could the hand loom do that ? I have operated power looms using 400 ends per inch, and successfully, and I contend that the power loom on account of the greater number of ends which can be lifted, gives the designer more scope.

Mr. Woodman—Efficiency of output or effectiveness of treatment must not be regarded as the artistic side of weaving. The old draw loom produced fabrics quite equal in quality from the artistic point of view to the finest modern power loom. We ourselves are continually experimenting with our power looms, but up to the present we find that the personal touch which characterises hand loom weaving cannot be obtained on the power loom. It does not necessarily follow that two fabrics each of 400 ends per inch, the one woven in a power loom, and the other in a hand loom, will have the same delicacy of handle or appearance. Otherwise nobody would employ hand looms. We often have orders for certain tissues with peculiar effects, and we find that these effects are more easily obtained on the hand loom.

Mr. Shearer—When one considers the full potentiality of the modern power loom, there seems to be some possibility of producing completely new designs. The invention of the jacquard removed the restrictions of the draw loom, and the modern power loom should to a certain extent remove the restriction of the hand jacquard.

Mr. Woodman—I quite agree.

Mr. E. B. Fry—Mr. Shearer has mentioned 5,000 hooks (here Mr. Shearer interrupted—"5,000 or more"), I have seen looms using six jacquards with 1,200 hooks each, i.e., 7,200 hooks. I could imitate that Louis XVI. fabric on a power loom and you could not tell the difference.

Mr. Shearer—Taste is improving, especially women's taste. Look at the shops now and compare them with 20 years ago—the quality and design of fabrics displayed has improved to a remarkable degree.

Mr. Fry—Were not the early designs chiefly used for tapestries ?

Mr. Woodman—Yes, it was not until about the late Gothic period, that is the 15th century, that furnishing and dress fabrics parted ways. Previous to that time all figured silk designs were used for the dual purpose.

Mr. Anthony-Langsdale—I have great pleasure in moving a vote of thanks to Mr. Woodman for his very excellent paper. I have always understood that the earliest forms of design, at any rate as far as Egyptian tapestries are concerned, made use of allegorical subjects such as chariot races, or games of quoits. Is it not possible that use might be made to-day of allegorical designs ?

The vote of thanks to Mr. Woodman was carried by acclamation.

DESIGN AND STRUCTURE OF WOVEN FABRICS

THE TEXTILE INSTITUTE'S "CROMPTON" PRIZES FOR 1926

ALSO SPECIAL PRIZE AWARDS FOR FABRICS AND FOR FANCY YARNS

The Committee of the Textile Institute concerned with the adjudication of the specimens submitted for the current year's competitions announce awards as under—

WOVEN FABRICS

First Prize (Certificate and £35)—L. B. Sutcliffe (Bradford Technical College).

Second Prize (Certificate and £25)—E. J. Poole (Bradford Technical College).

Third Prize (Certificate and £15)—M. Taylor (Salford Royal Technical College).

Prizes of £5 each—Miss G. Holsgrove (Burnley Technical College); H. Ayrton (Clitheroe Technical School); R. Ingham (Burnley Technical College); W. Taylor (Burnley Technical College); A. Mutton (Burnley Technical College); J. Walton (Nelson Technical School).

NOVEL WOVEN FABRIC

Special Prize of £10 for specimen of cloth of original and novel texture—L. B. Sutcliffe (Bradford Technical College).

WOVEN FABRIC (SPECIAL STUDENTS)

Special Prize of £5 for specimen of cloth submitted by a candidate for Honours Grade (Section A) of the City and Guilds of London Institute in the same year—R. Jackson (Nelson Technical School).

YARNS

Prizes of £5 each—C. Sumner (Blackburn Technical College); A. Eccleston (Blackburn Technical College); J. Woods (Blackburn Technical College).

The Committee report that although the number of participants in the principal competition is slightly lower than in some previous years, yet the general character of the specimens submitted is exceedingly good. The competitions are limited to advanced students, and fluctuations in numbers of contributors is therefore only likely to take place within very narrow margins. Advance in achievement by competitors is a consideration of far greater importance than advance in mere numbers of competitors. The specimens for this year represent a considerable stride forward. Improvements in many directions are effected, and especially gratifying is the more widespread tendency to aim at the retention of commercial value along with attractive structure and design. In some instances, however, competitors might have given greater consideration to tendencies indicated by current retail trading activities. Watchfulness in regard to vogue possibilities is always of extreme importance.

There were 10 contributors to the principal competition; 7 competitors for the special prize of £10; 3 for the prize of £5 for special students; and 3 for the yarns competitions. Two additional awards of £5 were made in the principal competition.

The prizes for yarns form a new feature of Institute competitions, due to the offer of Messrs. R. Greg & Co. Ltd., South Reddish, Stockport, who have kindly provided the necessary prize money for a period of three years. Notwithstanding the submission of but three sets of yarns, the Committee welcomes the commencement made. The specimens indicated that the general principles to be pursued are well understood. Ingenuity in colouring and twist is shown by all, though generally the results show a tendency to overreach in the matter

of cost of production. A general omission from details is the finished count of the yarn—a most important factor in relation to price.

In regard to next year's competitions, the Committee, as in previous years, have carefully revised the conditions. It is recognised that change is more or less inevitable from time to time if progress is to be maintained. Due to representations made to the Committee at a recent conference, somewhat drastic alterations have been effected in the conditions set out in the prospectus for 1927, and both students and teachers are urged to study the revised conditions and to assist as far as ever possible in promoting the success of the scheme. The prizes are again extended, and the Committee earnestly hopes that more individual firms will come forward and offer prizes, thus maintaining steady development of the scheme of competitions as a whole.

PRESENTATION OF PRIZES AND CERTIFICATES

Address by Mr. James Morton, of Carlisle

The presentation of prizes and certificates, in accordance with the foregoing list of awards, took place at the Institute, Manchester, on Saturday, 11th December. Mr. Wm. Howarth, J.P. (President), occupied the chair, supported by Mr. John Crompton (Chairman of Council), Mr. H. P. Greg (Vice-President), and Mr. J. D. Athey (General Secretary). Mr. James Morton (Carlisle) kindly attended and presented the prizes on behalf of the Institute. There was a large attendance of representatives of the Institute, and of numerous technical institutions, whilst students and others interested in the competitions attended from various textile centres. The exhibits were effectively displayed, and the availability of draping specimens of a number of the competitive fabrics added greatly to the interest of the display. The President welcomed the visitors and called upon Mr. Morton to distribute the prizes and, subsequently, a hearty vote of thanks was accorded Mr. Morton and the President, on the motion of Mr. Crompton, seconded by Mr. Greg. Incidentally, Mr. Crompton stated that the Competitions Committee would be pleased to consider special effort in regard to furnishing fabrics, Mr. Morton having expressed preparedness to help, if possible, in this connection. At the close of the presentation proceedings, afternoon tea was served in the Institute Council Room.

In presenting the prizes, Mr. Morton delivered a highly interesting address, as follows—

THE NEXT FORWARD STEP IN OUR TEXTILE INDUSTRY

By Mr. James Morton (Carlisle)

I must first of all thank your Committee for inviting one from the North into this atmosphere of young weavers. I am sorry to say it is now difficult to find such gatherings in Scotland. In former days, Glasgow and Paisley were weaving centres second to none in the world, but a generation or two ago young men seemed to forsake weaving as a vocation, with the result that a great deal of the special work formerly done there gravitated to Lancashire. Many young folks, perhaps, did not look upon weaving as an important enough industry and were attracted by newer industries more talked of, such as shipbuilding, engineering, electrical work, and the like. So, in case there should be any feeling among the young folks here that textiles and weaving are not worthy of their best brains, it may be useful to take stock of ourselves a little, to see what our industry embraces, the elements that go to the making of it, and the wonderful nature of the tools at our disposal. We are so familiar with them and we take everything so much for granted, that, like the old mystic "Snarley Bob," in L. P. Jacks' "Mad Shepherds," it is good sometimes to get out of our own globe and see our earth from outside—from another planet.

Now, what do we find to be the essential tools of the weaver, and what part and importance do they seem to play in the world's economy? The first, of

course, is fibres—the basis of all textile structure—cotton, linen, wool, silk, and its young, bright, synthetic sister. Do we quite realise what very varied activities these create ? In cotton, can we picture those scores of thousands of growers in the sunny southern lands of America, in Egypt, and elsewhere—the planting, the growing, the picking, the packing, the baling, the shipping overseas, and all the variety of life that these involve ? In wool, can we think of the breeding of the sheep, the pasturing in home, colonial, and other lands, from Australia to the high tablelands of Peru, the shearing, and all the teeming agricultural activities till the wool is baled, shipped, and landed at our various docks ? Can we follow the mysterious culture of the silkworm and its cocoons of silk under varying conditions of life from China, through India, right west to Italy and Southern France ? And, in another direction, can we realise the marvellous industry by which chemical and engineering skill have at last evolved for us a fibre brighter even than silk itself, though not so soft and kindly ? Then, on top of all that growing and garnering from the world's end, there is the varied manipulation of all these fibres—the sorting, the spinning, doubling, and twisting into all sorts of forms and sizes by thousands of spinners with their millions of whirling spindles. And all for what ? What have all those varied and far-spread activities been preparing for ? What for but to provide us weavers with the first of our tools—the raw, uncoloured yarn for the warp and woof of our web. Does it not make us feel just a little bit important to have such manifold servants at our call ?

But all these activities went to produce only the first of our tools—our fibres. The fibres provide only the structure of our cloth. It is colour that makes them speak, and that is our second essential tool. We have all heard a great deal in recent years of the development of chemistry, of the early discovery of Perkin's Mauve, of the great chemical factories that grew up in Germany as a result of this and similar discoveries; of the more recent developments in our own country and America—vast numbers of young men graduating at Universities and entering chemical factories, gigantic works, and combines, running into many millions sterling, and engaging the best brains of chemical science. And all, again, for what ? Very largely that they may provide dyes to colour the warps and wefts of the weaver. It is a rather staggering thought—this enormous scientific activity and ingenuity just to provide us with this second tool for our work. Engineering supplies us with our third tool, namely, the Mechanics of the Loom itself—a science which has developed as wonderfully as any already named, and which I scarcely need enlarge upon in a meeting of weavers.

I want to impress upon this meeting of young weavers the reality and the significance of this vast service that has thus been put at the disposal of our trade—this world-wide activity in science and commerce, all for the one specific purpose of equipping us with the tools of our industry. For these tools, we must remember, are incomparably more efficient and more valuable than any that have been available to weavers in the past. Fibres and yarns are more plentiful, more varied and more beautiful than have ever been produced at any period in the world's history; colours and dyes are in greater variety, more plentiful, and incomparably faster to all tests than in any previous age; and the mechanism of production puts opportunities to-day in the hands of the weaver that our grandfathers never even dreamt of. Botany, biology, chemistry, physics, and engineering have all so collaborated for our service that we are equipped as no other weavers in any age.

Now, how does it all strike us ? It certainly must impress us beyond any doubt with the vast importance that is attached to our craft in the world's economics, and the question we must ask ourselves is—How have we used these new and wonderful opportunities ? For, be it remembered, without a weaver, without the master weaver to direct, not one of these tools would be of the slightest practical value. Have we risen to our occasion ?

Suppose, like Snarley Bob, we creep again outside our globe and try to get a more comprehensive view of our own specific trade. It will be seen, I think,

that it divides itself into two broad divisions—two almost distinct grades of work. There is, first, the making of cloth that may be called a purely utility article—cloth that will hold together and wear, is wanted at the lowest possible price at which it can be made to serve its purpose, and, in many cases, is the raw material for other trades. There is, secondly, cloth with some form of decorative value—cloth that besides serving a more or less useful purpose has as an essential feature some æsthetic or decorative quality.

In the first section, I think we have reason to congratulate ourselves that the weaver has risen valiantly to the occasion. He has manipulated his new tools to such purpose that he has galloped abreast with the services of all the other sciences, and it may be said that, in this section, Lancashire led the world in the race. Why, I suppose that a score of spinners and weavers to-day will produce as much cloth as did the whole of Lancashire a hundred years ago, and one mill in Lancashire and Yorkshire will produce as much cotton and woollen cloth respectively as did the whole country at the beginning of the last century. Not only so, but, in the facile handling of these new tools, especially in the earlier period of the discoveries, this country so made good her opportunities that she was practically the weaving shop for the rest of the world. It was a wonderful achievement, and brought untold wealth and prosperity to these islands, and to no part more so than to the county of Lancashire.

Now, what about the other section of our craft—the decorative, which must always be much the more interesting for the real weaver? How did it fare through these hectic times? It is very difficult to have two really live and driving enthusiasms at one time, and I think it will be admitted that the real enthusiasm in the early generations of mechanical weaving in this country—and perhaps I may be allowed to say of Lancashire in particular—was concentrated on the mechanism of production, of mass production for world markets of more or less purely utility types. The novelty of the mechanism was so interesting and fascinating. It was like the interest we feel in our new motor cars which we hoped would carry us into all kinds of enjoyable natural scenery. We get so wholly absorbed in the pure mechanism and speed of the car that angels might be passing and we should never see them! That was all very natural and understandable, and, at first probably inevitable. But it had its dangers and limitations, and was bound to have its reaction. For other countries soon coveted our machines, and prepared to make their own requirements. Tariffs rose up to help, with the result that we have now reached a stage when many of the countries that once kept Lancashire busy are now making for themselves, and Lancashire is being faced with a problem new in her textile history. It is a stage that has been foreseen for many years, but the economics of the war have done much to hasten it. With the needs of our more complicated civilisation, with the wages, rates, and taxes inseparable from our higher standard of living, and expensive municipal and Government services, it is impossible that we in this country will ever be able to compete with many of the less advanced peoples in services which they can equally render. This means, without any doubt, a gradual shrinking of the trade in this country for purely utility merchandise. And the great problem for us, to-day, as textile manufacturers—Lancashire and others—is whether we are ready for the next forward step. This step undoubtedly lies in the direction of what is known as the Decorative Fabrics—more difficult to create, but intensely more interesting—fabrics that depend for their value and merit, not purely on their mechanical construction, or their cheapness, but on the skill and interest in their construction, the beauty of their design, and the sympathetic manipulation of their colour effects. It seems to me that we have arrived at what may be the testing time for our craft, and it is this phase that gives value to such projects as we are met to aid to-day. It was this aspect of things I am sure that prompted Mr. Crompton to inaugurate these competitions as notes of encouragement in the new direction.

It is a big problem how best to stimulate interest and develop taste for the finer side of decorative textiles, how best to develop these faculties so that they will translate themselves into the work of everyday life. We have had many movements in the form of art classes and museums, but want of a driving necessity has perhaps made those less real and vital than they otherwise would be. But there is no mother like necessity, and I have great hopes that when it once gets into the minds of the weavers of this country that a new departure is vital to our existence we shall rise to the occasion. I should like to impress this upon you young weavers with all the force I have. In our country, we have in the future to depend more and more on individual, high-quality work; others can do the simple and more mechanical work. Let us seek out things to do that are difficult. That is where there is lots of room, and where you can least be followed. When all the world is running away with your mechanical, monotonous work, get on to something better, something that is of greater interest in the making and that can command its own market. We must weave thought and interest into our fabrics. It is for this that the world will look to us more and more, and this we must be prepared to give. If the people of our country are educated to want and to enjoy a higher standard of living, it must be made evident in our products if the world is to pay the price that our higher wages and higher costs entail. And let us never fear that there will be a market for the best that we can think or do. Even in this poorer world, there is an ever-increasing number of people who can appreciate things of individual character and beauty. In spite of high tariffs in America, for example, there is an ever-increasing demand for work of that individual character. It is a type of work that conditions of life in America make difficult of production in their own country, while there is an ever-increasing number of educated people who are able to appreciate those higher individual products, and who have the wherewithal to pay for them. In our own country, also, there is an ever-growing public to welcome products possessed of personality and individual character, and, as things settle down, and other countries of the world again get into regular production, wealth will become more general and the demand for these higher class fabrics will be ever on the increase. To meet this greater demand for individual work may mean a considerable recasting of our industry; in many cases it will involve substitution, other types of looms, and it will mean a new outlook on the part of the weaver and the manufacturer. There may be less bulk, but not less value nor necessarily less profit. It need not mean less labour, while that will be of a far more interesting and educated type.

And in this direction, surely, lies the great opportunity for those new tools already spoken of. It seems to me we shall only then be making worthy use of them. I often think of William Morris worrying over the fugitiveness of his dyes and sticking to his indigo as almost his one sheet anchor. How he would have revelled in the galaxy of fast colours that would now be at his command. If you young weavers want to get smitten with some of the enthusiasm of your craft, read the life story of William Morris and carry it into your everyday job. He was out of his time, but it is his keynote we want to catch now, even for the Lancashire looms. For it is just that livingness and freshness, and individuality, which he put into his fabrics and all his products, that the world will want from us. Someone said, in describing another of his crafts, that "Morris began to stain his wallpapers with poetry." It is something of that we want and that will be more and more expected of us by the markets of the world. To equip ourselves, we want to dip into the finest old products of the past, not to copy or imitate, for those were produced by methods and under conditions that are no longer ours. But we want to feel what there is in them that has made them live and that make them thrill us to-day like an old song. We are too afraid of ourselves in these times, too self-conscious, too timid of putting anything of our real selves into the things we design or do. Yet, that is just the secret of these fine old masterpieces; they are so spontaneous and unconscious. Look at some of the old Peruvian

textiles, for example, the fun and drollery in the figures, and the superb colouring. What fun the old weavers must have had in making them. That fun is in them for us to enjoy to-day. Can we catch something of their spirit ? To-day "the world is so full of a number of things," of such infinite variety and interest on which we all have thoughts of our own. Why should not those find expression in the designs and colourings of our fabrics, and so make them modern living things ? Why should we be content to continue making copies of old documents that have now lost their meaning for us, when there is so much to say and portray about our own times and surroundings ? We are apt to take our art exercises far too seriously, to sweat ourselves into impossible attitudes to find something that does not or never did exist, and that can make no living appeal. We need only to be natural and spontaneous, to express something of what we feel of the beauty and interest in the life and living things around us as did those old craftsmen who carved those simple, roadside flowers and fruits and those interesting animals and grinning gargoyles that make our ancient buildings live and speak to us to-day.

"We waste endless pains," says Anatole France, referring to some modern artists, "in copying old armour and old oak chests. The artists of olden days never troubled their heads with such like pedantry. They gave the heroes of legend or history the costume and appearance of their own contemporaries. Thus, they depicted for us in natural colours their soul and their century. Can an artist do better ? Each of their personages was someone of their own circle, and these figures, living pictures of their life and thought, remain for ever touching. They bear witness to future times of sentiments and emotions actually experienced. . . . It is the artist's part to love life and show us it is beautiful."

But I can well imagine someone saying that these things surely belong to the High or Higher Arts and are outside the domain of mere textiles. Just so ! And that is where we are so apt to misunderstand and under-estimate both ourselves and our craft. For art is really one. We started on this little survey, this little stocktaking of ourselves, with the object of finding out what place and relative importance our industry bore in the world economics—how we stood in relation to the sciences and other new activities.

Now, I want to say something rather under one's breath, as it were, in this meeting of purely textile friends. I have had occasion during the past dozen years to be largely immersed in the work of chemists, in the developing of dyes and the application of them to the various fibres. In that way, I have had to meet and work much with chemists, from the highest to the ordinary working staffs. And—let us whisper very quietly—I feel that they are ahead of us in their craft, that the chemical and mechanical achievements that have been put at our disposal have outrun the uses that we, as weavers, have so far been able to put them to. We have been provided by science with the most wonderful tools and materials, but that is not enough. We must add to them that alchemy which alone can make them into things of living beauty. We must handle them and fondle them and blend them into a harmony that can only come from the spirit of the true artist. That is the real function of the master weaver, and the spirit in which I commend you young weavers to take up your task. It is the master tool of our craft—a live sense and instinct for the beautiful and the faculty to translate that into the everyday work of our hands. If we can catch that spirit and hold it, the future will still be ours, and, as our mechanical bulk business inevitably slips from us, we shall be making for ourselves new markets that will be surer and more permanent than we have ever had before. And we shall be doing work that will not only give lasting pleasure to the users of our products but that will bring ever-increasing joy to ourselves in the doing. And this is no fancy, but is the practical advice of one who has had 40 years' experience and knows the truth of it all so well. So good luck to your fishing !

NOTES AND NOTICES

Meeting of Institute Council

At the December meeting of the Council of the Institute, the proceedings were less protracted than usual. It was reported that satisfactory progress had already been made with respect to the programme of papers to be presented at the next Annual Conference, at Bolton, during next Whit-week. The President (Mr. Wm. Howarth) is taking a keen personal interest in the fixture and the arrangements. An excellent programme is contemplated. It was decided to record on the minutes an expression of the Council's keen regret on account of the death of Lord Emmott. Minutes of various Committees were accepted, and, arising out of the matter of library accommodation at the Institute premises, the question as to whether any rearrangement of the premises could be advantageously carried out was referred to the Finance Committee, with power to add. At the conclusion of the meeting the Chairman (Mr. John Crompton) wished the President and members a happy Christmas.

The Institute's Invested Funds

Mr. T. Fletcher Robinson, Hon. Treasurer of the Institute, emphasises the importance of the note which appeared in last issue in reference to the Foundation Fund, and to the adoption by the Council of recommendations of the Finance Committee in favour of extension of the application of the principle of investment of funds. In so doing, Mr. Robinson points out that the Foundation Fund, started by the late Sir William Mather during his presidency, and also given special impetus by the efforts of Sir Frank Warner, in his period of presidential office, has already proved of enormous benefit. The Institute's work and its developments could not possibly have been maintained in the absence of supplementary income from investments. The late Sir William Mather's judgment as to the future financial needs of the Institute was characteristically far-sighted. Investment of funds and the application of annual revenue by way of interest may represent movement which is slow, but it is sure and permanent. The Institute is yet young in years, and no safer policy than investment of any available funds can be pursued. The Institute's great work of publication of scientific and technical literature represents an annual expenditure which has advanced enormously in recent years. The volume of matter for publication continues to increase, and it is therefore quite appropriate that the keeping alive of the interest in our Foundation Fund should have been specially urged. The original project aimed at a fund of £50,000; we have reached the stage of £12,000, in round figures. Usually donations have ranged between £1,000 and £50, but even smaller sums would be heartily welcomed. It has been decided that, for the future, all subscriptions received in respect of Life Membership of the Institute shall be invested. A single membership subscription of not less than twenty guineas covers the financial obligation for Life Membership, and henceforward members who decide to seek permanent membership by payment of the amount stated, or over, will at least have the satisfaction of knowing that the contribution involved will help towards the permanent upbuilding of the Institute.

Meetings at Institute Headquarters

Arrangements have been concluded for the delivery of a Chadwick Trust Lecture at the Institute in February next. Provisionally the event is fixed to take place at 3.45 p.m. on Friday, 25th February, under the auspices of our Lancashire Section. The Chadwick Trustees have notified that Dr. C. S. Myers,

Director of the National Institute of Industrial Psychology, will contribute the lecture, and the meeting will be open to the public. Another fixture of particular interest is provisionally arranged for Friday, 11th February, at the Institute, when it is expected that Professor Paul Krais, of Dresden, will attend and speak on the subject of textile research in Germany. Professor Krais will be at Bradford on the 10th February, when he is to address a meeting of the Society of Dyers and Colourists, and it is anticipated he will come along to Manchester the following day.

A Comparison of Juvenile and Trained Judgments

On 11th November, Mr. Henry Binns, Chairman of the Yorkshire Section Committee of the Institute, addressed a meeting in the Great Northern Victoria Hotel, Bradford, and took as the basis of his remarks a paper contributed by him to this *Journal* (see pages T615–T641 of this issue), entitled "A Comparison Between the Judgments of Individuals Skilled in the Textile Trade and the Natural Judgments of Untrained Adults and Children." The contribution, said Mr. Binns, was a long one and he did not propose to read it, but to draw attention to its salient points and to some wall charts he had prepared of this and parallel investigations, which gave interesting and striking confirmation of his conclusions in respect to the basic factors of judgment and the influence of training thereon. Mr. Binns proceeded to outline his investigations and to describe the methods employed, and in conclusion answered several questions put from the audience. Mr. Thomas Boyce, Director of Education for Bradford, who presided, expressed the opinion that the application of psychology to industrial pursuits had entirely justified itself, particularly in the direction of the economy of human effort, the rate of output, and the selection of young people for special employment. A hearty vote of thanks to the lecturer terminated the proceedings.

Textile Institute Diplomas

Elections to Fellowships and Associateships of the Institute have been completed as follows, since the publication in November of the previous list—

FELLOWS

CRAIG, George Lorimer (Huddersfield)
HIGHLEY, Arnold (Bradford)
MARBLE, Edwin H. (Worcester, Mass., U.S.A.)

ASSOCIATES

BOLTON, Harold Samuel (London)
HARTLEY, James (Colne)
THREADGOULD, George Henry (Harwood)

Publications added to the Institute Library

October to December 1926

Books

Report of the Bombay Millowners' Association for the Year 1925.
Skinner's Cotton Trade Directory of the World, 1926-1927.
Annuaire Pratique des Industries Textiles Belges et du Vêtement, 1926.
Official American Textile Directory, 1926.
Express Metric Quotation Reckoner. J. G. Inglis.
Modern Industrial Tendencies. Sir Charles Macara.

Pamphlets

British

Smoke Abatement League of Great Britain, 7th Report.
Royal Society of Arts—List of Fellows, 1925-1926.
Industrial Fatigue Research Board. Sixth Annual Report.

Industrial Welfare Society. Eighth Annual Report.
City & Guilds of London Institute: Report of Department of Technology, 1925-'26.
Flax Supply Association. Fifty-eighth Annual Report.
Guild of Calico Printers, Bleachers, Dyers & Finishers' Foremen. Year Book, 1926-'27.
Scotch Tweed, Vol. IV., Parts 1-4.
Lister's Magazine, October 1926.

COLONIAL

Union of South Africa. Bulletin No. 9, Science Bulletins 45 and 53.
Trade of the Union for March, April, and May, 1926.
Nyasaland Protectorate. Annual Report of the Department of Agriculture, 1925.
Uganda Protectorate. Annual Report of the Department of Agriculture, 1925.
Jamaica: Department of Science and Agriculture. Microbiological Circular, No. 5.
Barbados. Report of the Department of Agriculture, 1925-1926.
Bengal, Bihar, and Orissa, and Assam. Final Forecast of Jute Crop.
Assam. Annual Report of the Department of Agriculture, 1925-1926.
Punjab. Department of Agriculture. Report on the Season and Crops, 1925-1926.
Punjab. Department of Agriculture. Annual Report of Experimental Work, 1926.
National Research Council, Ottawa. Reports Nos. 17 and 19.

FOREIGN

U.S.A. Bureau of Standards.
Scientific Papers, Nos. 522, 527 to 531.
Technologic Papers, Nos. 314, 316 to 321, 322, and 324.
Circular, No. 304.
United States Department of Commerce.
Elimination of Waste Series, Nos. 39,-41, 50, and 51.
Georgia Experiment Station. Circular No. 79.
Guam Agricultural Experiment Station.
Extension Circulars 2 and 3.
Bulletin No. 5.
Reports for 1921-1924.
North Dakota Agricultural College.
Bulletins 194-199 (1926).
Circulars 26-33 (1926).
National Association of Cotton Manufacturers, Boston.
Year Book for 1926.
Transactions, Vol. 118-119.
Index to Transactions, Vols. 1-119.
The American Society for Testing Materials.
A.S.T.M. Tentative Standards, 1926.
A.S.T.M. Standards Adopted in 1926.
Silk Association of America. Twenty-seventh Mid-year Report, September 1926.
"Etudes et Observations Effectuées sur des meches et des files de lin dans le but d'en ameliorer Les Methodes actuelles de Production." J. Dantzer and O. Roehrich.
"Notes on the Constitution of an Unimproved Cotton Crop." B. G. C. Bolland.
Tables Annuelles de Constantes et Données Numeriques: Art de l'Ingenieur et Matallurgie. L. Descroix.
Le Coton. A. Laliere.
Ingeniors Vetenskaps Akademien. Handlingar. Nos. 49-53.
Ministry of Agriculture, Egypt.
Technical and Scientific Bulletins. Nos. 63, 68, and 70.

Additions to Institute Membership

At the November meeting of the Council of the Institute, the following were elected to membership—W. C. Appleton, jun. (New England Sales Manager, Viscose Co.), 1017 Hospital Trust Building, Providence, R.I., U.S.A.; John Callander (Research Chemist), 1 Christie Street, Paisley, Scotland; Alfred Crickmore (Journalist and Editor), *Textile Mercury*, 20 Mount Street, Manchester; Andrew M. Donaldson (Jute Manufacturer), c/o Wm. Fergusson & Sons, Ltd., Dudhope Works, Dundee; Thomas Eastwood (Cotton Spinning and Weaving Manager), 20 Fenton Street, Rochdale; H. Gair Greg (Cotton Spinner and Doubler, Director), Lode Hill, Styal, Manchester; Arthur Hollas (Cotton Manufacturer), Heaton Grange, Bolton; Weston Howland (Assistant Treasurer, Cotton Manufacturing), c/o Warwick Mills, 49 Federal Street, Boston, Mass.,

U.S.A.; Leonard Kleeb, jun. (Manufacturing Hosiery), c/o Ipswich Mills, Ipswich, Mass., U.S.A.; James E. Lea (Manufacturer of Water and Coal Measuring Apparatus), c/o Lea Recorder Co. Ltd., 28 Deansgate, Manchester; Wilfrid L. Middleton (Manager of Card Cloth and Card Wire Works), c/o John Whiteley and Sons, Brunswick Mills, Halifax; Henry C. Olpin (Research Chemist), East Dene, Victoria Avenue, Borrowash, nr. Derby; William Peers (Retired Cotton Spinner and Manufacturer), Walshaw, nr. Bury; B. R. D. Sharp (Weaving Manager), 8 The Ives, Lidget Hill, Pudsey, Yorks; John Tattersall (Cotton Merchant), 206 Royal Exchange, Manchester; Frederick A. Tomlinson (Cotton Merchant &c.), Mayfield, Timperley, Altrincham; Cyril J. Whitelegg (Research Chemist), c/o J. Hardcastle & Co. Ltd., "Blackrock," Turton, nr. Bolton; Douglas G. Woolf (Associate Editor), *Textile World*, 334 Fourth Avenue, New York, N.Y., U.S.A.; William C. Evans (Wool Student), c/o Technical College, Bradford, Yorks; Allan Fouracre (Textile Tester), Long Lane, Harden, nr. Bingley, Yorks; W. L. Langton (Foreman Dyer), 131 Broomhill Road, Bulwell, Nottingham; Ernest Long (Cloth Salesman), 2 Langham Road, Seedley, Manchester.

At the December meeting of the Council, the following were elected to membership—M. V. Ashworth, c/o S. A. White Martins, Rua S. Pedro 67, Brazil (Foreign Representative, Textile Machinery); W. Bastard, Frog Island Mills, Leicester (Worsted Spinner); J. H. Brunskill, 42 Milton Street, Padiham (Power Loom Overlooker); F. W. Cannon, The Poplars, Sugden Street, Ashton-under-Lyne (Departmental Manager—Artificial Silk Importers); J. L. Crabtree, 2 Dunkirk Crescent, Warley Road, Halifax (Student); W. F. Edwards, 13 Browne's Terrace, Englewood, N.J., U.S.A. (Textile Chemist and Physicist); C. J. Elliott, 9 Sandringham Road, Ainsdale, Southport (Chief Electrical Engineer); Walter Garner, 312 Kensington Grove, Duckworth Lane, Bradford, Yorks. (Textile Research Chemist); Adam Glover, 55 Widdows Street, Leigh (Weaving Specialist to Courtaulds, Ltd.); Graham Hayes, John Berry & Sons, Ltd., Ashburton, S. Devon (Managing Director—Woollen Manufacture); H. S. Hele-Shaw, 64 Victoria Street, Westminster, London, S.W.1 (Emeritus Professor, Liverpool University); William Hilton, 193 Stamford Street, Brooks Bar, Manchester (Technical Inspector—Artificial Silk); Herbert Jones, Madura Mills, Madura, S. India (Cotton Carding and Spinning Master); R. O. Kohner, 11 Kirkham Road (Horton), Bradford, Yorks (Student of Textile Technology); William Lightbown, 124 Rochdale Old Road, Bury (Textile Engineer and Works Manager); R. B. Liley, "Glenholme," Westfield, Horbury, nr. Wakefield (Dyeing Supervisor and Manager of Shoddy and Rag Department); R. A. Lunn, No. 1 Ewangelicka, Lodz, Poland (Cotton Spinning Mill Manager); R. J. Mann, "Elandene," Cherry Tree Hill, Chaddesden, nr. Derby (Tinctorial Chemist, British Celanese, Ltd.); J. Martin, "Milnrow," 273 Blackpool Road, Deepdale, Preston (Head Textile Designer, Horrockses Crewdson & Co.); G. Osumi, 354 Shimmei, Komagome, Hongo, Tokyo, Japan (Professor of Tokyo Higher Technical School and Lecturer of Tokyo Higher Sericultural School); J. Preston, 47 Great Townley Street, Preston (Loom Overlooker and Teacher in Cotton Weaving, Textile Drawing, and Mechanics); Arthur Roberts, 41 Johnson Street, Tyldesley, nr. Manchester (Cotton Spinning, Head Tester, Howe Bridge Cotton Spinning Co. Ltd.); Norman A. Roberts, 73 Holborn Street, Mayfair Gardens, Rochdale (Secretary and Salesman—Cotton Spinning); C. D. Silas, c/o E. D. Sassoon and Co. Ltd., 73 Whitworth Street, Manchester (previously in charge of mills in India, now Head of Manchester Branch); Fred Smith, Cliff Mills Dyeworks, Bruntcliffe, nr. Leeds (Dyer); J. W. Sutcliffe, c/o James Stott, Ltd., Werneth Mills, Oldham (Business Manager); George D. Sutton, 62 Dorset Street, Haulgh, Bolton (Research Chemist); J. Rowland Wylde, "Mayfield," West Bollington, nr. Macclesfield (Apprentice Textile Engineer).

COMMUNICATIONS

Air Conditioning in Textile Mills

A review of a book with the above title, published by the Parks-Cramer Company, which appeared in our September issue, has resulted in the following correspondence passing between the Editor of the book and the reviewer. The correspondence appeared of such general interest that permission was sought from the two gentlemen concerned to publish their letters, which accordingly appear below.—Editor, *Journal of the Textile Institute*.

Letter from Mr. A. W. Thompson, Vice-President, Parks-Cramer Company, to Reviewer.

Dear Sir,—As I have read with considerably interest some of your valuable contributions to British and American magazines published for the textile trade, it occurred to me that the review of "Air Conditioning in Textile Mills," published in the September number of the *Journal of the Textile Institute* over the initials "S.A.S." was probably of your authorship. The complimentary nature of the first portion of the review is greatly appreciated, but I find myself somewhat puzzled by the exception taken to the remark on page 213—"The general laws relating to regain in textiles as deduced from the research of Hartshorne and his predecessors are now generally accepted . . . ." While believing that the statement in question was misinterpreted, the exception is perhaps justified by the existence of some work on the subject which has failed to reach me and in that case I hope you can, and will, give me some further light on such work as has been done under the auspices of the British Textile Research Associations, which is in direct opposition as is stated in the review. In explanation of the intended meaning of the statement in question, I would call attention to the fact that the statement itself refers specifically to the general laws relating to regain and hygroscopic equilibrium, which are summarised on pages 214 and 215 immediately following the statement, and if you will re-read the statement itself and the matter immediately following it to which the statement specifically refer, the original meaning of the statement will perhaps be more clear.

I am quite well aware that Mr. Shorter, in some of those articles which I have read, takes strong exception not only to Mr. Hartshorne's methods but to the correctness of certain portions of the latter's regain tables as published; but I am not aware that there exists any well-grounded dissent on the part of experts from the statements contained in paragraphs one to seven inclusive as printed on pages 214 and 215 in the publication under review. If any of these statements are seriously questioned by yourself or other experts, it is the writer's sincere desire to be fully informed on the subject. There is, of course, considerable controversy and sincere and honest difference of opinion between experts on such highly technical subjects. In compiling the handbook under review the present writer endeavoured throughout to avoid such controversial subjects and to treat the subject as a whole broadly and to avoid a too dogmatic and detailed treatment of the subject. I trust you will, therefore, understand that it is the writer's sincere desire to avoid any controversial discussion, seeking merely to correct his own impressions wherever they may be in error, and to add wherever he can to his general knowledge of the subject.

Because of the thorough and complimentary nature of your review of the Handbook, which is fully appreciated, I shall especially appreciate your reply.

Yours, &c.

Boston, Mass. (Signed) A. W. Thompson

14th October 1926.

Reply from Mr. S. A. Shorter to above letter.

Dear Sir,—I very much appreciate your interest in my review, and your desire to be fully informed on the subject of moisture regain. The latest work

on this subject is so recent that Chapter VII. of your book, though up-to-date at the time of writing, became out of date while going through the press. As you are probably aware, this sudden resuscitation of this important, but hitherto neglected, branch of research is due to the establishment of our textile Research Associations. A complete review of recent work in its relation to earlier researches is impossible in a letter, so that the best plan will be to consider the laws summarised on pages 214 and 215 of your book. Law I states that "in a given mass of material in hygroscopic equilibrium with the atmosphere to which it is exposed, the regain depends upon the humidity and temperature." This law is not true. It has been shown that the regain of cotton in an atmosphere of given humidity and temperature is greater when it attains equilibrium by gaining moisture[1].

Law II. is much too vague to deserve calling a "law" and too vague and non-commital to call for criticism.

Law III. is subject to the same criticism as Law I. The statement relating to the similar behaviour of "clean specimens of the same material" is certainly true for wool[2], and very probably true for other materials.

Law IV. does not deserve calling a "law."

Law V. states that "at a given relative humidity regain is less at high temperatures than at low." This is generally true, the only known exception being cotton at high temperatures and high humidities[3]. The quantitative forms of the above qualitative law, given in small type below it, are not true[3 and 4].

Law VI. is an alternative form of Law V. Law VII. is merely an approximate rule for mill practice.

The above brief criticism may be still further condensed by saying that the elimination of what is either immediately obvious or entirely non-committal from the seven laws leaves three definite statements, namely, Law I., the large type portion of Law V., and the small type of Law V., of which the first and last are untrue.

I am aware that the above criticism is merely destructive. In this case, however, constructive criticism would mean a re-writing of this section of your book, and this is a task of which you are just as capable as I am. If ever you think of doing this in a future edition, you will have the satisfaction of bringing the regain section up to the high standard set by the remainder of the book.

I append a bibliography of recent work on moisture regain.

Yours etc.,

(Signed) S. A. SHORTER.

[1] Urquhart and Williams. J. Text. Inst., 1924, **15**, T138.

[2] Shorter and Hall. J. Text. Inst., 1924, **15**, T305.

[3] Woollen and Worsted Research Association. J. Text. Inst., 1924, **15**, T559.

[4] Shorter. J. Text. Inst., 1924, **15**, T238.

REVIEWS

Cotton Spinning: Intermediate. By T. Thornley. Ernest Benn, Ltd., London (494 pp. and Index, 25s. net).

This book will be found to be a very useful addition to the Textile Institute and similar libraries. To the cotton spinning student and those engaged in the trade it fulfils the part of a text-book and also a book of reference. The price may, however, be detrimental to its popularity. This is a pity, as the subject is dealt with in a very practical manner, although in parts the subject matter is arranged rather disjointedly.

Chapter I. commences with a short statement of the principles involved in cotton spinning. This is very commendable, as the early treatment of the subject in this way adds interest to the non-student reader, while the student prefaces his study of the subject by obtaining a clear understanding of the whole principles involved, before studying their application in detail to the different

processes. The history in Chapter II. is very interesting, and the chronological table given must have entailed considerable research on the part of the author. The history and development dealt with at the commencement of each subsequent chapter of the respective machines used in the various processes is a new and welcome feature in the book. The process of mixing, opening, and scutching is very fully explained in Chapter III. The lecture diagrams are varied, and the descriptions of working parts excellent. The addition of diagrams and explanations of the present day requirements in such things as locking motions, lap guards, &c., together with useful prospective views, completes an excellent, full, and understandable description of the manipulation of the cotton in this process.

The four succeeding chapters deal with carding, combing, drawing, and fly frames in a similar manner. Here again are many very clear diagrams with full explanations as to practical working requirements of small but necessary details in such things as stripping combs and brushes, grinding rollers, &c., in cards, down to such simple parts as cap bars and traverse motions in fly frames. In fact the book excels in practical information, and it rightly includes such features as the duties of operatives under the Bolton Card Room List. The calculations on the respective machines at the end of each chapter are sufficient for all working changes. They are given with data from each respective machine and worked out in such a way as to be easily followed by the average student, and with few exceptions by the ordinary mill overlooker and operatives.

Chapters VIII. and IX. are devoted to spinning. This takes up over one-third of the book. The subject matter is very varied, and the practical knowledge gained from a careful study will repay perhaps the extra perusal necessary to get at the particular point sought. Had the arrangement of the matter in these two chapters been more methodical and in sequence the book would have gained unstinted praise. Having to collect from different parts of the same chapter points relative to the same part of the machine will no doubt reward the diligent, but the ordinary reader and student hopes to find all the data relating to the machine dealt with, collected, and arranged in sequence. Chapter X. deals with high-drafts. There are very good descriptions—supplemented by diagrams—given of the various patents. This is a very valuable and interesting addition to a phase of drafting which is at present engaging the attention of the most progressive minds in the trade. Practical results in high-draft yarn are such that the method must have a place in any text-book on cotton spinning. Chapters XI. and XII. give a varied assortment of recent examination papers appertaining to cotton spinning and its cognate subjects. Had the numerical answers been given where such are required, it would have added to its value as a text-book for the home or private student.

Altogether the book is a clear, full, and practical treatise on the middle processes in cotton spinning, and undoubtedly an advance on any of the author's previous works. It merits the reward of being in the hands of those engaged in the trade, and can be thoroughly recommended. J.H.

Skinner's Cotton Trade Directory of the World, 1926-1927. Thomas Skinner & Co., London (2,312 pp., 25s. net).

This is the fourth edition of what is now popularly known as "Skinner's," though this appellation will shortly have to be modified when the Wool Directory to be published by the same firm makes its appearance. Reviewing the 1925-1926 issue of this Directory, the writer characterised it as a herculean task to attempt to supply information in such detail of the cotton trade of the world. Such a description still holds good, and fresh credit must accrue to this firm for the manner in which the task has been undertaken and brought to fruition. Broadly speaking, the contents do not differ to any great extent in arrangement, but a fairly comprehensive addition has been made, giving particulars of cotton compresses and warehouses. A plea must once again be made for preserving the integrity of an editorial page. For example, cotton statistics commence on page 47, and do not reappear until three pages of advertisements have been passed. These statistics conclude most unexpectedly at the top of a left-hand page, and could quite easily be overlooked. The reviewer is, after twelve months, more firmly convinced than ever that an advertiser probably gets full value

for a special position facing editorial matter, but that an advertisement on an editorial page is merely a source of annoyance. It is to be noted that a slip supplied by the publishers points out that subscribers may have their copies of the Directory bound in sections if they so desire, and such a provision probably overcomes any individual objection to such a large volume. The book as a typographical and binding effort is praiseworthy, and a previous criticism that the guide tabs did not appear to be strong enough must be withdrawn, as a year's service has had no apparent effect on these conveniences. H.L.R.

Official American Textile Directory, 1926. Bragdon Lord & Nagle Co., New York (1,126 pp., 15s.).

This Directory is compiled by the *Textile World*, which in itself is adequate testimony to the excellence of the production. It contains reports of all the textile manufacturing establishments in the United States, Canada, and Mexico, together with a yarn trade index and lists of firms selling to or buying from textile mills. The first part consists of a list of textile establishments arranged alphabetically and geographically, and maps are supplied showing the location of textile districts. Part II. deals with raw materials, and in similar arrangement gives lists of merchants and brokers of cotton, silk, wool, waste, &c. In addition particulars are given of bleaching, dyeing, printing. and finishing concerns, and the book is completed by a very comprehensive index. At first sight it appears as if editorial matter were on white paper and advertising matter on pink paper, but this admirable idea is departed from in Part II., where coloured paper is used throughout. It would seem highly desirable to standardise the procedure in Part I. for the whole book. Of this, as of other directories, it is only possible to say either that the information supplied appears to be complete, or that in seeking certain information it has or has not been found. The Directory under notice certainly seems to fulfil the first condition, and so far has answered all demands under the second. It should meet the needs of anyone requiring a catalogue of the American textile industry. H.L.R.

Annuaire Pratique des Industries Textiles Belges at du Vêtement, 1926. Jules Bertrand and A. Laliere, Bruxelles (1,157 pp., 60 frs.).

Examination of the book under notice shows that it is divided into twenty sections each separated from its predecessor by a title page printed in six languages on strong coloured paper, and, of course, a list of the sections is provided at the beginning of the book, where also is to be found a list of Belgian towns and communes in alphabetical order indicating the provinces in which they are situated. In each section the information supplied is arranged under the names of the towns concerned alphabetically, and the whole range of information is complete. Section 10, dealing with clothing and accessories, is a deviation from the usual practice in compiling textile directories, and in this case, though it accounts for quite one-third of the total volume, does not result in an unwieldy book. Comment must also be made on the twelfth section, which gives particulars of Customs agents, ship brokers, and transport arrangements generally; this should be extremely useful. It is unusual to find particulars of makers of cardboard, office furniture, packing cases, paper, &c., in a directory of this kind, and the same remark applies to the next section (15), which gives a list of hotels, but the inclusion of these and particulars of calculations, imports, exports, and tariffs marks out this directory as one of extreme usefulness. H.L.R.

GENERAL ITEMS AND REPORTS

"Problems of Selling"

Miss Gladys Burlton, giving an address on the above subject before the Bradford Textile Society on Monday, 8th November, Mr. Arthur Hitt (President of the Society) being in the chair, said that salesmanship was more an art than a science, and it depended in the last resort upon personality, the right technique, and the ability to make use of science. Nevertheless the salesman must have at hand a great body of information ready for emergency; and not only was it necessary for that purpose, but it gave him a confidence that was felt rather than descried, and that was immediately recognised by the purchaser. It was a common saying that the customer was always right, and if the proverb were not taken too literally, it contained a great deal of truth. However excellent goods might be in the opinion of the manufacturer, if they were not excellent in the opinion of the public then they were not excellent Nowadays the public was more discriminating and more inquisitive in its shopping. Customers nowadays asked many questions—Will it wash ? Will it fade ? Will it stretch ? Will it shrink ? Will it wear ? How were these questions usually answered ? The manufacturers knew all about the subject, but were they successful in passing on their knowledge to the ordinary retail salesman and saleswoman ? She did not think so. There was an astonishing amount of ignorance, disastrous to the business concerned, on the part of the average salesman and saleswoman. There was, for instance, an astonishing lack of understanding about artificial silk. Such ignorance was really serious. It meant that there was a gap between the people who knew what was being produced and the people who had to sell it. The management of the firm was more to blame than anybody, because they should ensure that they had a really efficient and well-trained staff; but the idea of staff training was still looked upon as something rather freakish, and not a serious thing in building up a business. What was wanted as the next step in building up prosperity was to devote very serious attention indeed to the question of human efficiency in business. It had been overlooked astonishingly.

Mr. George Garnett said he thought a good deal that Miss Burlton had said would apply to the Bradford trade and any other trade. Staff training was supremely valuable to-day, and that statement was equally true whether one was dealing with retailing or with spinning, manufacturing, mending, or distribution. They could not expect to reach a better atmosphere in factories, and incidentally thereby a higher quality of production, unless they entertained a respect for those with whom they were daily associated, and went to the trouble of earning their confidence and helping to train them to do their work more perfectly. Time and money spent in educating people and getting them into a better mental attitude towards their work was money rightly spent; and far too little was spent on it, to the great loss of the trade.

Miss Burlton, replying to a question as to how the manufacturer could pass on his knowledge to the retailer, said more and more buyers were carefully reading the trade papers, and the manner in which advertising experts framed the advertisements meant that people were getting more definite information in that way. Many manufacturers also had got into the habit of attaching little leaflets or circulars to the goods they sent out; and that was an excellent method. With regard to staff training, a solution might be found if businesses would realise that they ought to spend a small percentage of their turnover—say one-fourth of 1%—on the training of their staff. The proper way was to have someone in the business whose whole mind was concentrated on the problem.

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TRANSACTIONS

1—MILDEW IN COTTON GOODS
THE GROWTH OF MOULD FUNGI ON SIZING AND FINISHING MATERIALS

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Summary

The paper deals with the relative liability of the more important sizing and finishing raw-materials to develop mildew damage. Flours, starches, dextrins, and gums were for the purpose of the investigation examined singly, while, further, the flours were only investigated in the unsteeped condition.

In the first place, the earlier literature on the subject of liability is reviewed, and a short account given of the origin and bio-chemical characters of certain of the substances investigated. The distinctions between cassava flour, cassava starch, and tapioca are specially pointed out.

The experiments are then described. These involved the cultivation of seven species of fungi, all obtained from cotton goods which had mildewed under ordinary trade conditions, upon size pastes and agar jellies.

For each of these fungi the rate of growth has been determined on the different sizing and finishing substances, and also the time taken to commence the production of spores for spreading the infection. This has resulted in the classification of the substances into groups according to their degree of liability to mildew.

I.—The dextrins and wheat, rice, and cassava flours, permit the most rapid growth and production of spores. Growth on the dextrins, however, tends to fall behind that on the flours after a time.

II.—An intermediate group is formed by wheat and maize starches, gum tragacanth, and soluble starch.

III.—The substances least liable to mildew are tapioca flour (cassava starch), sago, and farina. On these the fungi grew very slowly, and spore production was small. When treated with caustic soda, farina becomes quite unsuitable for the growth of mould fungi, as shown by the fact that only one species produced even slight growth on farina treated in this manner.

Finally, a brief interpretation of the results on bio-chemical grounds is advanced, the greater growth on flours than on starches being attributed to their nitrogenous and sugar content.

INTRODUCTION

In a previous paper, Bright, Morris, and Summers[2] have pointed out the complicated nature of the problem of mildew in cotton goods. The raw cotton itself may be infected and therefore a source of mildew trouble, or infection from the atmosphere and other sources may develop at some later stage between the conditioning of the yarn and the sale of the finished cloth. At one stage especially is mildew likely to occur, namely, after the warp has been sized. The reason for this is that, during sizing, the yarn is coated with substances such as flour and starch which are eminently suitable for nourishing mould fungi. Mildew spores—whether present originally in the raw cotton and yarn or occurring as infections subsequent to sizing—have therefore a favourable medium for development. Furthermore, in finishing

processes, it is customary to employ substances such as dextrin and vegetable gums, which may also serve as food materials for mould fungi and increase the risk of the appearance of mildew damage.

It becomes of importance therefore to know precisely the relation to fungus growth of all the substances used in sizing and finishing, so that, where possible, by judicious choice of constituents the danger of mildew attack may be minimised. This resolves itself into a study of the relative rates of growth and spore production of the different mould fungi which are likely to occur on the various materials used in the processes of sizing and finishing.

As far as sizing materials are concerned, certain opinions on the question of their liability to mildew are prevalent, but it is seldom clear whether these are based on actual experience or on the statements in technical handbooks. For example, it is often asserted that the starches obtained from the underground organs of plants, *e.g.*, roots or tubers, are less likely to become "mildewed" than those from aerial parts, such as stems or seeds. It is generally considered, too, that wheat flour is a much more suitable medium for fungus growth than farina or other starches, and on this account it is the practice to use an increased proportion of antiseptic with wheat flour.

In order to collect the existing information on the subject, a survey of the literature was necessary, and as no summary of it has been published previously, it was considered that this might with advantage form a section of the present paper.

Survey of the Literature

The technical handbooks usually present such views as have just been mentioned as mere statements of facts, but Davis, Dreyfus, and Holland[5] lay special emphasis on the part played by nitrogen content in producing differences in liability to develop mildew damage. They recommend the omission of wheat flour from size mixings (p. 57), "since . . . the starches generally . . . inasmuch as they only contain traces of nitrogenous matter produce a size less liable to mildew." In this connection they emphasise the importance of the estimation of nitrogenous substances in cloth analysis (*loc. cit.* p. 142), and state that "flour or flour paste is perhaps the soil of all others best adapted for mildew growths."

Farina is described by Davis and Dreyfus[5b] as a "non-nitrogenous material and but little liable to damage." Apart from this, and a suggestion by Bean[1] that the properties of farina depend on the character of the soil in which the potatoes are grown, there appears to be no mention of farina except in the tables of experimental results of Thomson[13], and Davis and Dreyfus[5] quoted below; but the general opinion of the industry is that a farina size is but little liable to damage by mildew. As will be seen later, this is confirmed by the present series of laboratory experiments.

The general properties only of rice flour and starch are given in the handbooks, but Thomson's table (see Table I.) shows that rice flour is but little less favourable than wheat flour as a medium for fungus growth, and a paste made of rice starch can be exposed to atmospheric infection twice as long as one of the flour before mould growths make their appearance.

Maize, or Indian corn-meal, is described by Davis, Dreyfus, and Holland (p. 71)[5] as not nearly so liable to mildew as wheat flour. Bean and Scarisbrick (p. 102)[1] say that a paste of maize starch will mildew much sooner than one of any other starch under the same conditions, and indicates that maize

flour is more liable to mildew than the starch, while Ermen[6] and Hadfield[8] attribute this greater tendency of maize starch to suffer from fungus attack to the presence of small agglomerations of starch and gluten. If these get on to the cloth, spots of mildew are liable to develop owing to the fact that gluten is a good fungus food, but it they are broken up by boiling such spots are less likely to occur.

Sago receives only general mention amongst the other starches, although opinion and experience in the industry show it to be but little liable to mildew. Direct experiments in this laboratory have confirmed this previously.[2]

Tapioca, according to Ermen[6] alone, is decidedly liable to give rise to mildew growths owing to the presence commonly of nitrogenous substances. It is frequently confused with cassava, which also has received scant attention from the authors of text books. In an anonymous paper in the *Bulletin of the Imperial Institute*[3] on the commercial development of this starch, it is, however, stated that "as a sizing material cassava *starch* would probably be found less liable than cereal flour to induce mildew in cotton goods on account of its much lower percentage of proteins."

Thomson[13] says that mildew does not grow either quickly or luxuriantly on dextrin, his experimental data for three kinds of farina dextrin appearing to support this statement.

With respect to gum tragacanth, Bean and Scarisbrick[1] mention the danger of the development of mildew on the small insoluble particles remaining if the gum is not sieved properly after steeping.

Experimental evidence on liability is advanced in only two cases. Thomson[13] determined "the lengths of time required for different starchy matters to allow the development of fungus life, after boiling each into a paste with water, in the proportion of 1 to 10." Davis, Dreyfus, and Holland[5] conducted a similar experiment and gave brief descriptions of the progress of the growth on their pastes when left in an exposed place. These results are combined in Table I. and further reference to the technique of the experiments is made below (p. T14).

Table I.
Time of Development of Mildew

	Thomson.	Davis, Dreyfus, and Holland.
Wheat flour	6 days (3 kinds)	9th day.
Rice flour	8 ,,	—
Maize starch	10 ,,	12–15th day.
Sago	10 ,,	12th ,,
Tapioca	10 ,,	—
Wheat starch	11 ,,	11th day.
Farina	11 ,,	16th ,,
Farina dextrin	16 ,, (3 kinds)	—
Rice starch	17 ,,	12–15th ,,

These results corroborate the general view that flours are more liable to mildew than starches, but disagree with Bean's statement[1] that maize starch will develop mildew much sooner than any of the others. Apart from this the two series of results differ in the detailed placing of the various starches.

In view of the paucity and conflicting character of the existing information, it seemed desirable to investigate the question of liability afresh, using

modern methods of mycological technique in place of the somewhat rough and ready procedure employed by earlier workers. Although the investigation is by no means completed, certain results have been reached which it would appear advantageous to communicate without delay.

THE PROPERTIES OF SIZING AND FINISHING SUBSTANCES

It may be advisable at this stage to give a few notes on the botanical and bio-chemical characters of some of the materials investigated in the present research, since a knowledge of these factors is essential to a full understanding of the relation of mildew growth to the substances concerned.

Botanical.

A description of the botanical origin and microscopical appearance of most of the flours, starches, and gums used as adhesives in sizing is given in so many technical handbooks that it need not be repeated here. Cassava, however, is not so familiar, and it may be as well to include a brief description of the various products of the plant, particularly as the nomenclature of these materials is considerably confused, the terms tapioca, tapioca flour, cassava, &c., being used apparently without discrimination. Restriction of these names to the sense in which they are used in the following account would eliminate this uncertainty.

The cassava plant[3] (known also as manioc) yields large, swollen root tubers, which occur in clusters at the base of the stem. In the preparation of cassava flour these roots are washed, peeled, and cut up. The pieces are then dried in the sun and pounded into a flour, which thus consists of all the constituents of the tubers, with the exception of the outside layers or rind. On the other hand, when cassava starch is being manufactured, the cleaned roots are grated to break up the cell walls and liberate the starch, which is collected in water and then dried in a vacuum drier or special kilns. If instead of drying in this manner the starch is heated on iron plates up to its gelatinisation temperature, the grains adhere together and the familiar granular lumps of tapioca are obtained.

Bio-Chemical.

The chemical composition of the materials used in sizing throws considerable light on the reasons for their different liability to develop mildew damage.

(i.) *Flours and Starches*—Whether obtained from seeds or other plant storage tissues, certain substances apart from pure starch are likely to be met with in commercial flours and starches, but to a less extent in the latter owing to the definite processes of separation which they undergo. Amongst these are various classes of proteins, such as albumins, which are soluble, and globulins, which are insoluble in water, and glutelins and gliadins, which are insoluble in water but soluble in dilute acid and alkali. Less complex nitrogenous substances, such as amides and amino-acids, may also be present, the relative proportions of these compounds varying to a wide extent. Non-nitrogenous substances such as fats and oils, mineral salts such as phosphates (which appear in most analyses as "ash"), and cellulose or "fibre" from cell wall residues are also likely to occur. Besides these impurities of botanical origin, the starches of commerce are also liable to be contaminated with acids and other substances employed during the processes of manufacture.

A selected number of analyses of flours and starches from various sources are collected in Table II.

Table II.

Percentage Composition of Flours and Starches

	Starch	Nitro-genous Matter or Gluten	Glucose	Gum and Dextrin	Bran, Fibre, or Cellulose	Ash and Salts	Water	Fat	Amides, Sugars, Gluco-sides	Resins and Organic Acids	Authority
Wheat flour (English)...	68·09	9·88	4·93	3·51	trace	0·81	12·78	—	—	—	Thomson, p. 70
,, (Chilian) ...	70·05	6·76	5·17	4·11	,,	0·60	13·31	—	—	—	,,
,, (Egyptian)	67·71	2·36	8·55	7·39	,,	0·47	13·52	—	—	—	,,
,, ...	66·27	11·08	3·33		—	0·26 0·44*	16·5	1·2	—	—	Davis, Dreyfus & Holland, p. 66
Wheat starch	82·81	—	—		1·16	0·16	15·87	—	—	—	,, ,, ,, p. 63
,, ...	80·06	—	—		1·14	0·06	18·74	—	—	—	,, ,, ,, p. 68
,, ...	81·23	—	—		0·87	0·08	17·82	—	—	—	,, ,, ,, p. 68
,, ...	83·3	1·9	—		0·3	0·4	14·0	0·2	—	—	Wiesner, Vol. II., p. 36
Rice flour	78·21	6·82	0·45		3·06	0·81	9·91	0·74	—	—	Thomson, p. 102
,, ...	79·50	6·30	—		—	0·50	13·00	0·70	—	—	Davis, Dreyfus & Holland, p. 72
Maize starch	81·59	—	—		0·64	0·33	17·44	—	—	—	,, ,, ,, p. 63
,, ...	84·1	1·5	—		—	0·4	14·0	—	—	—	Wiesner, Vol. II., p. 36
,, ...	83	1·53	—		0·09	0·38	14·91	0·09	—	—	,, p. 63
Farina	82·7	—	—		0·36	0·22	16·72	—	—	—	Davis, Dreyfus & Holland, p. 63
,, ...	80·0	5·0	—		—	4·0	10·0	1·0	—	—	Hadfield
,, (*a*)	79·6	0·7	—		0·1	0·3	19·2	0·04	—	—	Wiesner, Vol. II., p. 36
,, (*b*)	80·8	1·0	—		—	1·0	17·2	—	—	—	,,
Sago	86·2	0·5	—		—	0·4	12·9	—	—	—	,,
,, ...	81	1·88	—		trace	0·4	16·7	trace	—	—	,, p. 63
Cassava flour	64·63	1·31	—	2·85	2·96	1·86	10·56	1·50	13·69	0·43	Bull. Imp. Inst., 1915, **13**, p. 598
,, ...	70·13	1·31	—	5·63	4·15	1·13	11·86	0·86	4·5	0·64	,, ,, ,,
Cassava starch ...	82·96	0·84	—		0·0	0·20	15·80	0·20	—	—	,, ,, ,, p. 603
,, ...	84·09	0·46	—		0·75	0·70	13·70	0·30	—	—	,, ,, ,,
Tapioca	88·95	0·30	—		0·0	1·00	9·30	0·45	—	—	,, ,, ,,
,, ...	85·6	0·30	—		0·0	0·20	13·60	0·25	—	—	,, ,, ,,
,, ...	86·82	1·68	—		0·0	0·50	10·60	0·40	—	—	,, ,, ,,
,, (Manioc) ...	83	0·70	—		0·06	0·20	15·88	0·16	—	—	Wiesner, p. 63

* Potassium phosphate.

The starch is the largest percentage component which can be utilised as food by fungi, but the variation in amount from one type of commercial flour or starch to another is not sufficient to cause any appreciable difference in the extent to which growth can occur on them. The pure starches are, however, not identical, such properties as the shape and size of the grain, the temperature of gelatinisation and the viscosity of the pastes produced with water exhibiting well-known divergencies. These characters though, are not such as to affect the nutrition of fungi, nor are the more obscure variations in physical and chemical constitution, except in the raw starch. The mildew problem of the cotton industry is therefore not concerned with such factors. According to Reichert[10] "boiled starches, whatever their source, are of equal digestibility" (*i.e.* by enzymes—which constitute the means of attack of fungi living on them), "yielding quantitatively and qualitatively the same saccharine products" (which determine fungal growth after the enzyme attack has been made). It is, then, to the impurities, which are certain to occur in the preparation of starch on a commercial scale, that one must look for the cause of differences in liability to develop mould growths.

Apart from moisture, the next most abundant constituent, and probably the most important from the present standpoint, is the nitrogenous matter, all of which is frequently included in the term "gluten." The quantity of this varies from over 10% in a hard wheat flour, through about 2% in some wheat starches, down to nothing in others. The variations which occur in the analyses of the same starch may be due to actual differences in the samples studied or partly to the divergent methods and classifications adopted by the different authors. The general relation of the existence of a higher percentage of gluten in the flours than in the starches is shown quite clearly, but, except possibly in the case of maize starch, the figures are not constant enough to place the starches themselves in anything like a definite order.

That differences with respect to gluten exist between hard and soft wheats is now recognised, but, in spite of the very large amount of research on the subject, it is not yet clear whether they are entirely or partly a matter of quantity or quality of gluten. The point of view seems recently to have shifted towards a recognition of the importance of quality, but results so far are not conclusive. The possibility of a greater amount of fungus growth occurring on the one than the other cannot therefore be usefully considered at present, although some experiments on both types of flour will be described in the present paper.

The presence of sugars is also likely to have a considerable influence, for owing to their solubility they are readily available for purposes of nutrition. Sugars may even be more important than some nitrogenous substances, for Chaudhuri[4] has recently found that the omission of maltose from a synthetic culture medium had a much greater effect in diminishing the growth of one species of fungus than the failure to supply asparagine in the same medium when maltose was present. Sugar occurs most abundantly in wheat and cassava, and to a less extent in maize and rice flours, but is absent from the starches owing to its removal by the washing process involved in their manufacture.

Except in dirty specimens which contain sand, the ash content of a starch represents the amount of contained salts. Of these, phosphates are always present, and Fouard (quoted by Stocks[12]) found the amount of phosphoric

acid in a starch containing 0·331% of ash to be 0·1915%. This amount may be too small to produce a nutrition effect of any magnitude, but as the phosphates affect the degree of acidity or alkalinity of the starch, they may in this manner alone exert some influence on fungal growth. The result of this will, however, vary considerably with the different species of fungi. Generally, the flours contain more ash than the starches, the figures for which show marked divergences.

Where data are given, fats also show a preponderance in the flours. Maize flour appears to be outstanding in this respect and may possibly contain enough fat to have an appreciable effect; the rest most probably do not.

The last constituent—variously described as bran, fibre, and cellulose—is not such as to affect the liability to mildew of the starch or flour concerned.

(ii.) *Soluble Starches*—These are prepared in a variety of ways, either by heat or by treatment with acids, alkalis, or oxidising agents such as chlorine, hypochlorites, or perborates. It is possible that the traces of these reagents left in as impurities may by themselves cause differences in the behaviour of the product. The starch itself has probably undergone a molecular change of the nature of depolymerisation and the size of the molecule may have been reduced,[12] but the alteration in solubility is more likely to be of importance. Dextrin is also frequently present and the mineral content is usually higher than in ordinary starch,[12] but unless the impurities are such as to cause a marked difference, a soluble starch should be intermediate in properties between its parent starch and the dextrin obtained from it.

(iii.) *Dextrins*—Dextrins are obtained from starches by acid, heat, or enzyme action, and so may be expected to vary considerably in their composition both as to the carbohydrates present and the residues of the reagents employed in their manufacture. These will affect the reaction of the product and appreciable differences may exist, for example, between an acid- and a diastase-dextrin; but variations in acidity do not affect all species of mould fungi in the same way. Some samples may still contain a proportion of unconverted starch or soluble starch, whereas in others the conversion will have proceeded so far that the sugars maltose and glucose may be present (see Table III.). These being soluble can be absorbed at once by mould fungi and growth may, at least, start off more rapidly on the dextrin than on the corresponding starch.

Table III.
Analyses of Dextrin—Percentages

	Dextrin	Glucose	Unaltered Starch &c.	Water	Mineral Matter	Authority
Province of Langa-salza Dextrin	72·45	8·77	13·14	5·64	—	Davis, Dreyfus, and Holland
Dark British Gum	70·43	1·92	19·97	7·68	—	,, ,,
Light British Gum	5·34	0·24	86·47	7·95	—	,, ,,
Brown Dextrin ...	63·60	7·67	14·50	14·23	—	,, ,,
Brown Commercial Dextrin	83·76	4·84	—	11·03	0·37	Bean and Scarisbrick

(iv.) *Gums*—The gums are not relatively simple carbohydrates, such as starches and dextrins, but partake of the nature of glucosides and acids.[7] On hydrolysis, they yield the sugars galactose and arabinose, which are suitable for fungal nutrition, but as the hydrolysis is not brought about as readily as that of dextrin to glucose, the gums are probably not as suitable substrata for mould growth as the dextrins.

Gum tragacanth consists of two parts. The first, which is made up of insoluble salts of the gum, produces a gel with water, whilst the second is composed of soluble salts of calcium, magnesium, and potassium. A certain amount of starch is present as an inclusion in remnants of cell tissue, and at times sugar may occur.[14] Traces of nitrogen are also present in the gum, the ash of which is largely chalk (50%), with a small amount (3%) of phosphates. Several analyses of gum tragacanth are recorded in Table IV.

Table IV.

Analyses of Gum Tragacanth—Percentages

Insoluble pectic substance	Soluble Gum	Starch and Cellulose	Ash	Water	Nitrogenous Bodies	Authority
60	8–10	5—6	3	20	Traces	Bean[1]
60—70	8–10	—	—	—	—	Haas and Hill[7] (p. 123)
—	—	—	3—5	About 17	·05	Stocks[12]
About 50	—	Starch, enough to blue iodine; cellulose, negligible	1·75—3·57	11—17	—	Wiesner[14] (Vol. I., p. 137)

THE SUBSTANCES INVESTIGATED

The materials studied in the present series of experiments, although not forming a complete set of the adhesives used in sizing and finishing, are none the less fairly representative. The remaining substances are being actively investigated and will be discussed in a later paper. The wheat flours were used in the unfermented state; the results of an investigation into the effects of steeping, which form a separate part of the general problem, are recorded in the succeeding memoir.

The following is a brief description of the materials employed; where not otherwise described they were ordinary commercial samples.

(1) *Strong (=hard) Wheat Flour*—A commercial mixture of Manitoba and Russian flours.

(2) *Weak (=soft) Wheat Flour*—A mixture of White Pacific, Chilian, and Australian flours.

(3) *Yeoman Wheat Flour*—Yeoman is an English wheat, bred originally at Cambridge by Professor Biffen. It combines the character possessed by Canadian hard wheats of producing a flour of good baking properties with the capacity of giving a yield per acre equal to that of the best English soft wheats.

(4) *Wheat Starch.*

(5) *Rice Flour.*

(6) *"Tapioca Flour"*—This sample was probably "Cassava starch," for it appeared to consist entirely of starch grains with no admixture of cell residues, and no proteins could be detected.

(7) *"Cassava"*—As this sample contained an appreciable quantity of cell residues, and also gave some of the protein reactions, it should be described as "Cassava flour."

(8) *Farina.*

(9) *Sago.*

(10, *a* and *b*) *Maize Starch*—from two sources.

(11, *a* and *b*) *Soluble Starch*—(*a*) This was a commercial sample found to contain both farina and maize starches. (*b*) Farina was the only starch in this specimen, which was prepared by Lintner's process.

(12, *a* and *b*) *Maize Dextrin*—(*a*) A white sample possessing an acid reaction. (*b*) The colour and smell of caramel indicated that this sample had been prepared by heat.

(13, *a*, *b*, and *c*) *Farina Dextrin*—(*a*) and (*b*) From different sources, but both white and acid. (*c*) Prepared in the laboratory by the action of diastase on a commercial farina.

(14) *Farina treated with* 1% *Caustic Soda*—Prepared according to Bean and Scarisbrick's method.[1]

(15) *Farina treated with* 1% *Caustic Soda and then Neutralised*—Sample 14 made neutral to litmus by the addition of dilute hydrochloric acid.

(16) *Gum Tragacanth.*

All the substances were examined qualitatively for proteins, sugars, and cell residues, to see that they agreed with the analyses given above in Tables II., III., and IV. Cell residues, proteins, starch, and dextrin were identified microchemically, and proteins and reducing sugars by macrochemical tests, namely, the xanthoproteic, biuret, and Millon's reactions, and the reduction of Fehling's solution. The results obtained are shown in Table V., in which + indicates a positive, ++ a very marked reaction, and failure to give the test at all.

Table V.
Qualitative Analysis of Materials

	Microchemical Tests					Macrochemical Tests			
						Proteins			Sugar
	Unchanged Starch	Changed (Burst, &c.) Starch	Dextrin	Protein	Cell Walls	Xanthoproteic	Biuret	Millon	Fehling
Wheat flours	+	0	0	+	+	+	+	+	+
Wheat starch	+	0	0	0	0	0	0	0	0
Rice flour	+	0	0	+	+	+	+	+	0
"Tapioca flour" ...	+	0	0	0	0	0	0	0	trace
"Cassava"	+	0	0	trace	+	+	0	slight	++
Farina	+	0	0	0	0	0	0	0	0
Sago	+	+	0	0	0	0	0	0	trace
Maize starch	+	0	0	0	0	0	0	0	0
Soluble starch (*a*) ...	+	0	0	0	0	0	0	0	trace
Soluble starch (*b*) (Lintner's) ...	+	0	0	0	0	0	0	0	+
Maize dextrin, acid ...	+	+	+	0	0	0	0	0	++
Maize dextrin, heat ...	0	+	+	0	trace	0	0	0	++
Farina dextrin, acid ...	trace	+	+	0	0	0	0	0	++
Gum tragacanth ...	+	0	0	trace	+	0	0	slight	+

THE EXPERIMENTAL INVESTIGATION

The Culture Media.

The materials were made up in two ways as media for the cultivation of fungi. For the first set a paste or pure size containing about 5 grams of the substance in about 100 cc. of size was used. With the exception of gum tragacanth, farina diastase dextrin, and the treated farina, this was prepared by grinding 5 grams of the substance into a thin paste with 25 cc. of cold tap water, and pouring this into 90 cc. of boiling water. The whole was then boiled gently for about five minutes, which treatment reduced its bulk. The farina diastase dextrin was prepared directly from a farina paste, made up as above, by adding diastase and keeping the temperature at 40° C. until a drop tested with iodine gave no trace of purple. The paste was then boiled up again to render the enzyme inactive.

The treated farina was prepared by heating 5 grms. of the starch with 115 cc. of 1% sodium hydroxide on a water bath for half an hour. One sample was used in this condition and the other was made neutral to litmus by the addition of dilute hydrochloric acid.

For the gum tragacanth media, 5 grms. were ground finely, steeped for a number of hours in 115 cc. of water, boiled, and used as in the case of the starches.

About 5 cc. of the pastes prepared in this way were poured while hot into test tubes, which were then plugged with cotton wool in the usual way for culture media and sterilised by heating in the autoclave at 15 lb. steam pressure for 20 minutes. This method gave a number of samples of starch paste, entirely free from living fungus spores or mycelium, which could be kept sterile or inoculated with pure cultures of any fungus at will.

For the second set of experiments, in which the growth rate of the fungi was studied, a solid medium was necessary, and this was obtained by the addition of agar-agar to the flour or starch paste. Agar-agar possesses very little, if any, nutritive value, and gives a transparent jelly with a neutral reaction. Three grms. of flour were ground with 15 cc. of cold water and poured into 75 cc. of boiling water and thoroughly stirred; 3 grms. of agar dissolved in 90 cc. of water and filtered, were poured while still hot into the flour paste, well mixed, and the whole then boiled for about five minutes. This medium was tubed and sterilised, and on cooling set to a stiff jelly. When required for use it was melted by heating on a water bath and poured into sterile Petri dishes, giving when cold a circular slab of jelly about 4 millimetres thick, the transparency of which varied with the starch used.

The Fungi.

Seven species of fungi were used as indicated in the table below.

Table VI.

Fungus	Description and Origin
1—*Penicillium* sp. 2 ...	A green species isolated from cops which had been stored in a box after conditioning.
2—*Penicillium* sp. 4 ...	Another green species from spotted printed calico returned from India.
3—*Aspergillus niger* ...	A black species from the same cops as No. 1.
4—*Aspergillus flavus* ...	A yellow-green species isolated from spots in Queensland raw cotton.
5—*Rhizopus arrhizus* ...	A whitish fungus from the same source as No. 4.
6—*Fusarium* sp.	A pink species also from the same source as No. 4.
7—*Cladosporium herbarum* ...	A greyish-green fungus obtained from coloured spots in West African raw cotton.

All of these were isolated from samples of material which had mildewed under ordinary industrial conditions, but the origin of the particular strains used does not represent the prevalence of these species. The third in the table, for example, has also been obtained from raw cotton of various types and from filled printed cloth, whilst the last species occurred in grey cloth woven from the same raw cotton, and again in several cases of warp mildewing. In short, the examination of numerous samples of cotton goods mildewed at all stages of manufacture shows that the fungi selected for this work are representative of the large number of species of the various groups of mould fungi which have been met with altogether.[2]

Plan of the Experiments.

Size Cultures—Pairs of tubes containing the starch pastes prepared as described above were inoculated with spores from pure cultures of the seven fungi just enumerated, and incubated at 25° C. (77° F.). They were examined periodically during one to three weeks, and the progress of growth observed. Records were kept of the first appearance of growth, and of the degree of spore production at any time, thus enabling comparisons on several different grounds to be made between the various materials as to their capacity for supporting the growth of mould fungi.

The classification of growth and sporing used for comparative purposes was into six groups, as follows—

0=No growth.
1=Growth, but no production of spores.
2=First signs of sporing.
3=Sporing definite but slight.
4=Sporing well advanced.
5=Sporing fully developed all over the surface.

Specimens of the original records arranged according to this scheme are given for *Aspergillus niger* and *Rhizopus arrhizus* in Table VII.

Table VII.
Classification of Growth in Size Cultures

Age in days	Wheat Flour			Rice Flour	Tapioca Flour	Sago II. 64	Maize Starch 52	Farina 82	Cassava 67	Soluable Starch 66
	Strong	Weak	Yeoman							
				Aspergillus niger						
4	1	0	1	1	0	0	0	0	2	1
6	4	3	5	3	0	0	0	1	5	2
7	5	5	5	3	2	0	0	1	5	3
8	5	5	5	4	2	3	2	1	5	3
9	5	5	5	4	2	3	3	1	5	4
				Rhizopus arrhizus						
2	4	3	3	2	0	0	0	0	3	1
3	4	5	5	4	0	0	1	0	5	4
4	5	5	5	5	0	0	3	0	5	4
5	5	5	5	5	1	0	4	0	5	4
8	5	5	5	5	3	2	4	2	5	4

It will be seen from this table that the classification of growth of either fungus varies from one material to another. For example, when the cultures were seven days old, *Aspergillus niger* had reached the groups 5, 1, and 0

on wheat flour, farina, and sago respectively. In words, it means that this fungus grew so quickly on wheat flour that it was sporing fully in seven days, by which time growth had only just started (Class 1) on farina, and had not yet appeared (Class 0) on sago. The larger the number, then, the greater the amount of growth which has taken place, and this applies for any fungus at any age. If, therefore, on a given day, the numbers of all the fungi are added together for each substance the resulting totals will give an indication of the amount of growth which has taken place, the larger the total the greater the growth, and therefore the greater the liability of the substance to develop mildew. This is the basis of the comparisons made later on from Tables X. (p. T15) and XIII. (p. T18), which thus take into account the growth of all the seven species at once.

Cultures on Agar Jelly—In the tube cultures just described, the growth of the fungi was restricted in area, the size of the colony being limited after the first day or two by the diameter of the culture tubes. The object of the second group of cultures on agar in Petri dishes was to study the capacity of fungi for spreading in a relatively unconfined space. Sets of three or four dishes, containing agar made up with the same sizing material, were inoculated centrally with spores of one fungus. When growth occurred the fungus was able to spread equally in all directions from the centre, and the average growth rate of the hyphæ in one sector being the same as that in any other, colonies which were approximately circular were produced (Plate I.). Two diameters (as nearly as possible at right angles) of the colony were measured, to the nearest millimetre, or half millimetre where the edge was exceptionally clearly defined, every few days, and the mean of the group of the three or four similar dishes calculated. By plotting the diameters for successive days, it can be seen that in most cases the growth rate is steady once the colony is well established. In a few instances, however, this is not so; the initial rate is not maintained and the graph shows a curve falling away from the straight line of the first few days. This means that with a given pair of substances growth may be more abundant on one at first, but eventually that on the other will overtake it. Apart from such cases, the graphs show clearly the differences between the growth rates on the various media.

The growth rates of four species of fungi were determined—

Penicillium 2, which gives colonies with a clearly defined edge, although its mycelium is colourless. On some media the reverse of the colonies, and even the medium itself, are coloured yellow. The growth of this species is relatively slow.

Aspergillus flavus grows more rapidly than *Penicillium* 2. Its mycelium is also colourless, but the edge of the colonies is distinct, although on some media it tends to become somewhat, though regularly, scolloped after several days growth.

Fusarium sp. grows much faster than the others and produces regular colonies, the edges of which are not easy to see on the more opaque media, but are usually quite even. A pinkish coloration in the medium is often developed.

Cladosporium herbarum has a coloured mycelium and produces clear slow-growing colonies.

To illustrate the consistency of the measurements, a specimen set of records for each fungus is given in the following table—

Table VIII.
Diameter of Colonies in Agar Cultures

1—*Penicillium* 2 on Sago.

Diameters to nearest 0·5 mm.

Age in days	Dish 1	Dish 2	Dish 3	Mean diameter	Increase per day
3	10·5×10·5	11·5×10	10·5×10·5	10·5	—
5	19 ×19·5	20 ×19	19·5×19	19·5	4·5
6	23·5×23·5	23 ×24	23 ×23·5	23·5	4·0
8	33 ×33	32 ×33	32·5×32·5	32·5	4·5
10	43 ×43	42 ×41	40 ×39	41·5	4·5
12	51 ×53	50 ×51	51 ×53	51·5	5·0
13	57 ×56	56 ×56	56 ×56	56	4·5

2—*Aspergillus flavus* on Farina.

Diameters to nearest 0·5 mm.

Age in days	Dish 1	Dish 2	Dish 3	Mean diameter	Increase per day
2	8 × 7	9 × 8	8× 9	8	—
3	14 ×13	14 ×15	14×14	14	6·0
4	20 ×20	21 ×22	20×21	20·5	6·5
5	26·5×26	27·5×27	27×26·5	27	6·5
6	33 ×33	34 ×34	33×33	33·5	6·5
9	51 ×50	51 ×51	50×49	50·5	5·5
10	56 ×58	58 ×57	54×54	56	5·5

3—*Fusarium* sp. on Yeoman Wheat Flour.

Diameters to nearest 1 mm.

Age in days	Dish 1	Dish 2	Dish 3	Mean diameter	Increase per day
3	31×32	31×29	31×31	31	—
4	44×43	42×42	42×45	43	12
5	57×57	57×57	56×58	57	14
6	72×72	71×71	71×71	71	14

4—*Cladosporium herbarum* on Lintner's Soluble Starch.

Diameters to nearest 1 mm.

Age in days	Dish 1	Dish 2	Dish 3	Dish 4	Mean diameter	Increase per day
3	10×10	11×11	11×11	11×11	11	—
5	20×19	20×20	20×20	20×19	20	4·5
7	28×28	28×28	29×28	28×28	28	4·0
10	40×40	41×41	40×41	41×41	41	4·5
12	48×48	49×49	48×49	48×48	48	3·5
14	54×54	55×55	55×55	55×55	55	3·5

The practical significance of the classifications obtained from these two types of culture should perhaps be pointed out here. The time which elapses before the observation of fungus growth—which on yarn and cloth is most frequently that of sporing—decides whether or not "mildew" will appear, for example during a week-end stoppage of the loom or during a period of storage of the cloth. The quantity of spores produced in a given time determines the amount of these which will be free to fill the air with infecting material on being disturbed. This is also dependent on the growth rate, for the quicker the fungus grows the larger will be the area capable of

producing spores for spreading, although the number of spores per unit area of colony will be lower on a poorer than on a richer medium.

Results.

First Series—Size Cultures. (*a*) A comparison of the sizing materials can first be made on the basis of the time which elapses between inoculation with a fungus and the first signs of its sporing—that is the period at which it becomes capable of spreading infection more rapidly than by mycelial growth alone. This comparison is of the kind made by Thomson[13] (p. 156), and Davis, Dreyfus, and Holland[5] (p. 96), but their pastes were left freely exposed to the air and became infected with several fungi at once—as was shown by the occurrence of both red and green spots.[5] It is also quite possible that the fungi on one paste may have been rapidly growing ones, spores of which did not settle on the other pastes until growth had started on the first. This state of affairs might, of course, be reproduced under practical conditions, but in the long run the chance of one particular species infecting, say, cloth sized with wheat flour or farina, will be equal. The present experiments eliminate this factor of statistical probability by effecting a simultaneous inoculation (with a single species) of all the materials studied, and each fungus employed is free to develop without the possibility of inhibition by the growth of other species.

Table IX.
Time in Days between Inoculation and Sporing

	Wheat Flour			Rice Flour	Tapioca Flour	Sago	Maize Starch	Farina	Cassava	Soluble Starch
	Strong	Weak	Yeoman							
Penicillium 2	3	3	3	6	15+	8	8	7	3	6
Penicillium 4	2	2	2	3	8+	8	5	8+	2	3
Aspergillus niger	5	5	5	6	7	8	8	12	4	6
Aspergillus flavus	3	4	4	6	12	12	7	6	3	6
Rhizopus arrhizus	2	2	2	2	6	8	4	8	2	3
Cladosporium herbarum ...	2	2	2	2	4	3	3	3	2	3
Fusarium	3	2	2	3	8+	8+	8+	8+	2	5
Totals	20	20	20	28	60+	55+	43	52+	18	32

As according to this classification the smaller the index number the greater is the liability to mildew, the table gives an indication of relative "liability," as follows—

Most liable—1 Cassava and wheat flours (unsteeped).
2 Rice flour and soluble starch.
3 Maize starch.
Least liable—4 Farina, sago, and tapioca.

(*b*) From the same set of cultures a second comparison can be made by considering the degree of development both of growth and sporing on a given day. All the cultures were observed when four and eight days old, and these times are convenient to use. At four days there is a distinction between substances on which growth has or has not occurred, and after eight days between the extents of sporing. The cultures of four fungi were kept on at room temperature and again examined after 31 days. In some cases the spores formed had germinated and produced a fresh mycelial growth. This necessitates the introduction of Group 6 into the classification.

Table X.

Classification of Growth and Sporing—Size Cultures

Age		Wheat Flour Strong	Wheat Flour Weak	Wheat Flour Yeoman	Rice Flour	Tapioca Flour	Sago	Maize Starch	Farina	Cassava	Soluble Starch
4 days	*Penicillium* 2 ...	3	3	4	1	1	1	1	1	4	1
	Penicillium 4 ...	5	4	4	3	1	0	0	1	4	3
	Aspergillus niger ...	1	0	1	1	0	0	0	0	2	1
	Aspergillus flavus ...	3	2	3	0	1	0	0	1	3	1
	Rhizopus arrhizus ...	5	5	5	5	0	0	3	0	5	4
	Cladosporium herbarum	3	3	3	4	2	2	3	2	4	4
	Fusarium	4	4	4	4	1	0	1	0	4	1
		24	21	24	18	6	3	8	5	26	15
8 days	*Penicillium* 2 ...	5	5	5	3	1	2	2	2	5	3
	Penicillium 4 ...	5	5	5	5	1	2	3	1	5	3
	Aspergillus niger ...	5	5	5	4	2	3	2	1	5	3
	Aspergillus flavus ...	5	5	5	3	1	1	3	2	5	3
	Rhizopus arrhizus ...	5	5	5	5	3	2	4	2	5	4
	Cladosporium herbarum	5	5	5	5	2	2	4	3	5	4
	Fusarium	5	5	5	5	1	1	1	1	5	2
		35	35	35	30	11	13	19	12	35	22
31 days	*Penicillium* 4 ...	6	6	6	6	3	3	4	3	5	4
	Rhizopus arrhizus ...	5	5	5	5	3	3	4	3	5	4
	Cladosporium herbarum	6	6	6	6	2	3	4	3	5	4
	Fusarium	5	5	5	5	3	3	5	3	5	4
		22	22	22	22	11	12	17	12	20	16

Substantially the same grouping as before is given at all these ages of the cultures, with cassava and the wheat flours as most suitable for growth. Growth on rice flour is somewhat slower at first, but eventually becomes rapid enough to overtake that on wheat flour. On soluble starch growth starts nearly as well as on rice flour, but slows up later, so that ultimately growth is about the same as on maize starch, on which the initial stages are slower. Farina, sago, and tapioca are again seen to be greatly inferior media for growth, for development does not proceed as far even in 31 days as on the first group of flours in four days.

First Series—Agar Cultures. In this series the growth rates of three fungi were measured, three dishes of the same flour or starch being inoculated with spores of each species. The typical examples of the daily measurements given above in Table VIII. show the evenness of growth, and so only the mean measurements of all the dishes are given here. The diameters of the colonies when five days old have been selected as representative for Table XI., whilst the complete series of mean measurements are shown graphically in Figs. 1, 2, and 3, which illustrate more clearly than the table the distinct behaviour of the three fungi. The most obvious difference is that *Penicillium* separates the sizing materials into two clear groups, *Aspergillus* into three, whilst the more quickly growing *Fusarium* merges them almost into one.

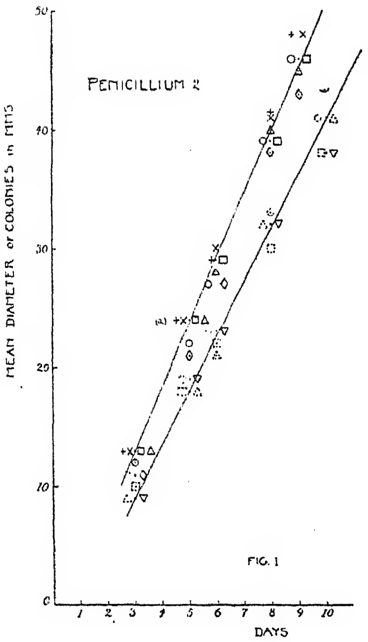

FIG. 1

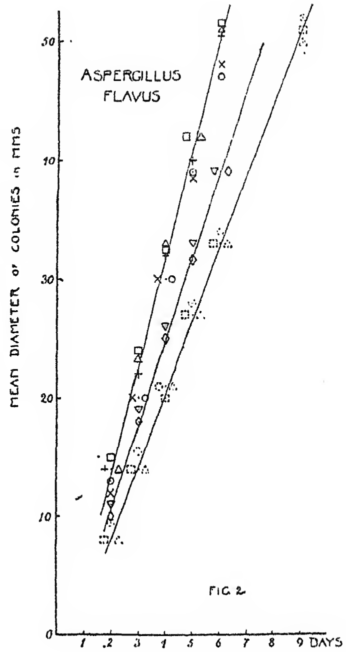

FIG. 2

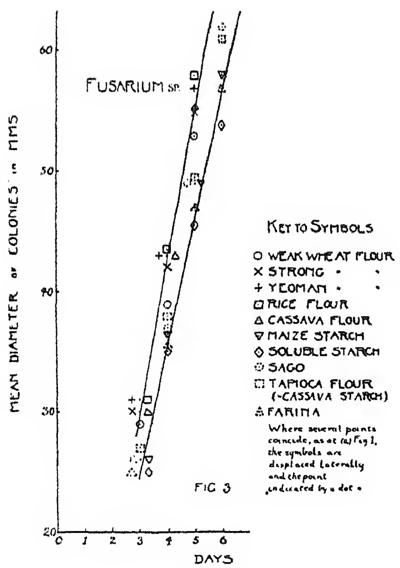

FIG 3

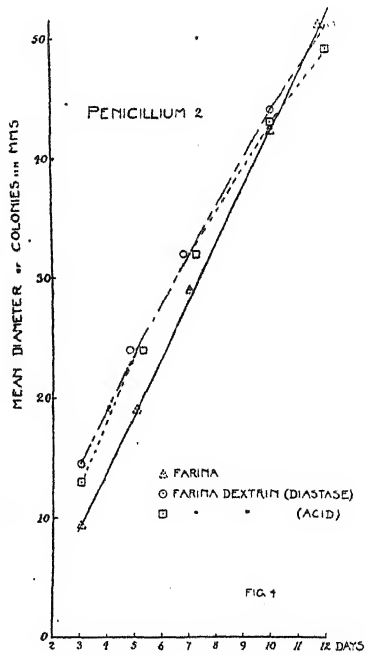

FIG. 4

Table XI.
Mean Diameter of Colonies Five Days Old—in. mms.

	Wheat Flours									
	Strong	Weak	Yeoman	Rice Flour	Tapioca Flour	Sago	Maize Starch	Farina	Cassava	Soluble Starch
Penicillium 2 ...	24	22	24	24	18	19	19	18	24	21
Aspergillus flavus	38·5	39	40	42	27	28	33	27	42	31·5
Fusarium ...	55	53	57	58	49·5	49	49	47	55·5	45·5
Totals ...	117·5	114	121	124	94·5	96	101	92	121·5	98

By considering all the fungi together, the following order is obtained—

Higher growth rate—Rice flour, cassava, and wheat flours (unsteeped).

Lower growth rate—Maize starch, soluble starch, sago, tapioca, and farina,

which agrees in general with the results obtained from the size cultures.

Second Series—Size Cultures. In this series the study was extended to other substances, certain of those examined before being repeated for comparative purposes. The maize starch and soluble starch were, however, from different samples. The procedure was exactly as before, and the results are set out below as in Tables IX., X., and XI.

In the concentrations employed, the cultures of dextrin and neutralised farina were liquid. Consequently, many of the inoculating spores sank to the bottom of the tube where growth started first. Spores were only produced when sufficient mycelium to reach the air surface had developed, thus making the dextrins appear less favourable for growth than they really are. In the farina diastase dextrin, growth was normal, and this alone is included in the table. Where normal growth occurred on the maize and acid-farina dextrins, it was, however, approximately equal to that on the farina diastase sample.

Table XII.
Time in Days between Inoculation and Sporing

	Wheat		Maize Starch	Farina			Lintner's Soluble Starch	Gum Tragacanth
	Flour	Starch		Untreated	Treated with Caustic Soda	Diastase Dextrin		
Penicillium 2	3	14	13	6	No growth	3	9	4
Penicillium 4	3	6	4	6	,,	3	16	3
Aspergillus niger ...	3	4	4	9	,,	2	6	2
Aspergillus flavus ...	3	6	6	6	,,	3	9	4
Rhizopus arrhizus ...	3	6	4	4	,,	3	3	3
Cladosporium herbarum ...	6	13+	9	13+	,,	2	9	4
Fusarium sp.	4	13	6	13	,,	4	16	16
Totals ...	25	62	46	57	—	20	68	36
Previous totals (Table IX.)	20	—	43	52+	—	—	32	—

This places farina diastase dextrin and wheat flour as giving most rapid growth, wheat starch, farina, and soluble starch the slowest, while gum tragacanth and maize starch form an intermediate class. The soluble

starch total is very different from that in the first series, but the wheat flour, maize starch, and farina agree reasonably well with the previous totals.

The degree of sporing after nine days is given in the next table, which is comparable with Table X.

Table XIII.
Classification of Growth and Sporing in Nine Days—Second Series

	Wheat		Maize Starch	Maize dextrin		Farina			Farina dextrin			Lintner's Soluble Starch	Gum Tragacanth
	Flour	Starch		Acid	Heat	Un-treated	Caustic treated	Treated and neut.	Acid 1	Acid 2	Diastase		
Penicillium 2	5	1	1	2	3	2	0	1	3	1	4	2	3
Penicillium 4	5	2	3	1	4	2	0	1	3	1	4	1	3
Aspergillus niger ...	5	3	3	3	3	2	0	1	5	1	5	3	3
Aspergillus flavus ...	5	3	3	1	3	2	0	1	4	2	4	2	3
Rhizopus arrhizus ...	5	3	4	3	1	3	0	1	1	3	5	4	5
Cladosporium herbarum	4	1	2	2	2	1	0	1	5	1	5	2	4
Fusarium	2	1	3	1	1	1	0	1	1	1	4	1	1
Totals	31	14	19	13*	17*	13	0	7*	22*	10*	31	15	22

* Medium liquid, and growth submerged.

Both these classifications give the order—

Greatest growth ... ... Wheat flour and farina dextrin (diastase).
Intermediate ... ... Gum tragacanth and maize starch.
Least growth... ... ... Soluble starch, wheat starch, and farina.
No growth ... ... Farina treated with caustic soda.

Second Series—Agar Cultures. Three fungi were again used for inoculating the Petri dish cultures, but *Fusarium* was replaced by *Cladosporium*. The mean diameters of five-day cultures are given in Table XIV.

Table XIV.
Mean Diameters of Colonies Five Days Old—mms.

	Wheat		Maize Starch	Maize dextrin		Farina			Farina dextrin			Lintner's Soluble Starch	Gum Tragacanth
	Flour	Starch		Acid	Heat	Untreated	Treated with Caustic Soda	Treated with Caustic Soda and neut.	Acid 1	Acid 2	Diastase		
Penicillium 2	25	22	20	27	24	19	0	23	24	24	24	21	24
Aspergillus flavus ...	35	33	30	35	37	30	0	43	31	32	36	30	31
Cladosporium herbarum	23	20	18	19	20	19	3	23	20	21	21	20	19
Totals	83	75	68	81	81	68	3	89	75	77	81	71	74

The totals show that on the farina treated with caustic soda *Cladosporium* alone produces very slight growth, whereas growth on the farina treated with caustic soda and neutralised is more rapid than on any of the other substances. This is largely due to *Aspergillus flavus*. Wheat flour and the dextrins come next in order, followed by gum tragacanth, wheat starch, soluble starch, maize starch, and farina. Especially in the case of *Penicillium*, growth on the dextrins is more rapid at first but slows down after some time, until, at about 12 days, the colony on the starch is equal to or

larger than that on the dextrin (Fig. 4). Thus, comparison at 10 or 12 days leaves the dextrins well behind wheat flour and about equal to the starches. This is, in all probability, due to the sugar content of the dextrin. The sugar, being immediately available as a food material for the fungus, enables this to forge ahead. As the sugar becomes exhausted, or staling products are produced, the growth rate decreases finally to become approximately the same as that on the starch.

The absence of growth, except of *Cladosporium,* on the farina treated with caustic soda is most probably due to the high degree of alkalinity of this medium, and not to any change in the starch itself. On neutralisation, this inhibiting alkalinity is removed and all the species are enabled to grow. The simpler substances formed by the breakdown of the starch now come into play, and being more easily available for growth than the starch itself, actually give a higher growth rate of the mould fungi, especially in the case of *Aspergillus flavus*, than on the untreated farina. In this case neutralisation after the treatment with caustic soda was brought about by the addition of hydrochloric acid, but probably the same effect would be produced by other acids or salts, such as magnesium chloride, which hydrolyse and give an acid solution. With zinc chloride this neutralising effect would naturally be opposed by its antiseptic action.

As in the first series, comparisons based on the two types of cultures show a general agreement, but wheat starch is placed much lower by the size than the agar cultures. Subsequent experiments, however, have shown that on size also, wheat starch gives definitely more growth than farina, and should be placed in the intermediate group.

Comparison of the Two Series—It now remains to link together the results of the two series of cultures. This can be done either by taking the actual figures obtained (using means for the substances tested in both series), or by finding some quantitative relation of the others to these in each case.

The extent of agreement between the two series of repeated substances may be gathered from the data of Table XV.

Table XV.

	Strong Wheat Flour		Maize Starch		Farina		Soluble Starch	
Series	1	2	1	2	1	2	1	2
Total Time of Sporing ...	20	25	43	46	52+	57	32	68
Growth Totals—								
Four days	24	21	8	9	5	7	15	6
Eight and nine days ...	35	31	19	19	12	13	22	15
Size of Colony at five days—								
Penicillium 2	24	25	19	20	18	19	21	21
Aspergillus flavus ...	39	35	33	30	27	30	32	30

The two samples of soluble starch differ greatly on the size cultures, but the others agree at least within the limits of grouping, and so the actual figures can be used to combine the two series of results; they are set out in Table XVI. The group numbers in the last column are obtained by combining those given by the results of the separate methods of comparison which occupy the other columns of the table.

Table XVI.
Grouping of all Substances by Degree of Liability

Sizing or Finishing Substance	No. of Days to Sporing	Growth Totals		Group Number
		Size (9 days)	Agar (5 days)	
1—Wheat flour (strong), unfermented†	22	33	62	1
2—Wheat flour (weak), unfermented† ...	20	35	61	1
3—Wheat flour (Yeoman), unfermented†	20	35	64	1
4—Wheat starch	62	14	55	3 ?
5—Rice flour	28	30	66	1
6—Tapioca flour (=Cassava starch) ...	60+	11	45	3
7—Cassava(flour)	18	35	66	1
8—Farina	55	13	47	3
9—Sago	55+	12	47	3
10—Maize starch	44	19	51	2
11 (*a*)—Soluble starch	32	22	53	2
11 (*b*)—Soluble starch (Lintner's) ...	68	15	51	3
12 (*a*)—Maize dextrin (acid)	—	13*	62	2 ?
12 (*b*)—Maize dextrin (heat)	—	17*	61	2 ?
13 (*a* and *b*)—Farina dextrin (acid) ...	—	22*	56	2 ?
13 (*c*)—Farina dextrin (Diastase) ...	20	31	60	1
14—Farina, treated with caustic soda ...	—	0	0	4
15—Farina, treated with caustic soda and neutralised	—	7*	66	3
16—Gum tragacanth	36	22	55	2

* Medium liquid and growth submerged, cf. p. T17.

† For fermented wheat flour see Table X. in "Mildew in Cotton Goods," Part III (following memoir).

Another method of comparison is by combining the growth rate results of the two series. *Penicillium* and *Aspergillus* were used in both series, and results from these can conveniently be taken together, or those given by *Fusarium* and *Cladosporium* included with little difference. The first-named pair give the following results relative to the size of the colony produced on strong wheat flour, which is taken as 100.

Table XVII.

Material	Growth Rate *Penicillium* and *Aspergillus*
Rice flour	108
Cassava (flour)	106
Farina (NaOH and neutralised)	106
Yeoman wheat flour (unfermented)	103
Strong wheat flour (unfermented)	100
Weak wheat flour (unfermented)	100
Maize dextrin (acid)	100
Maize dextrin (heat)	98
Farina dextrin (Diastase)	97
Farina dextrin (acid)	90
Wheat starch	89
Gum tragacanth	89
Soluble starch (*a*)	85
Soluble starch (Lintner's)	82
Maize starch	82
Sago	78
Farina	76
Tapioca flour (=Cassava starch)	74

This gives a grouping very like the former obtained by using the actual figures, except for the position of the treated and neutralised farina. This grouping is not strictly quantitative, as differences in the time of observation, the method of classification, and the species of fungus employed all have their effect in producing slight variations. Nevertheless certain definite points emerge and these have been confirmed a number of times in cultures on a larger scale. The amount of growth on wheat flour is about equal to that on cassava flour, but greater than that on wheat starch. Growth on the latter is greater than on either farina or sago, in which the rates are approximately equally low. The general relation also holds that growth on dextrins or flours is greater than on the corresponding starches.

DISCUSSION

The results of the present experiments confirm generally many prevalent opinions and text-book statements. Certain divergencies, however, are indicated. Maize starch does not appear to be so much more liable to mildew than the other starches, and under certain conditions it is the equal of sago, farina, and tapioca, on all of which less growth occurs than on wheat starch. The dextrins, too, are more suitable media for growth than the starches, and soluble starch appears to occupy a somewhat doubtful intermediate position in harmony with its equally uncertain chemical composition.

From the chemical point of view, one or two indications (see p. T4–8) can be obtained as to the cause of the differences exhibited by the different starches. The flours with their greater nitrogen and sugar content do support more growth than the starches, and, amongst the starches themselves, wheat and maize, with their nitrogen contents of 1·9 and 1·5% respectively (Wiesner,[14] probably the most reliable of the authorities quoted), approach the flours more closely than farina and tapioca with less than 1%. It should be remembered, however, that the samples investigated may have varied considerably from those for which the quantitative analysis is given, although qualitatively (Table V.) they agree to a large extent.

The sample of cassava (flour) contained markedly less protein than the wheat and rice flours, and yet it proved their equal for fungal nutrition—most probably because of its higher sugar content. Another illustration of the importance of sugars is afforded by the maize-acid-dextrin. In this the starch grains had not been fully converted to dextrin. Many were apparently unchanged, others which had burst still gave the unaltered starch colour with iodine, and few gave the definite brown which is given by the heat dextrin. Its sugar content was, however, high, and the greater growth on this dextrin than on the maize and soluble starches must be attributed to this factor.

In general, therefore, for all the sizing and finishing materials investigated, liability to develop mildew is closely connected with chemical properties, growth being invariably encouraged by the presence of sugars or nitrogenous material.

It should be remembered that this paper deals with materials used singly and not in commercial mixings containing softeners, weighting substances, &c., certain of which are chemically active and may exercise an important influence on the liability to develop mildew. The investigation of the growth of mould fungi on such mixings has been commenced, and it is hoped to publish the results in a later paper.

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DESCRIPTION OF PLATE I.

Photographs of Petri-dish cultures to illustrate the rate of increase in size of circular colonies.

Age of colonies from left to right—2, 4, 6 days.

Row 1—*Penicillium* 2 on Farina-agar.

Row 2—*Aspergillus flavus* on Farina-agar.

Note the greater growth rate of *Aspergillus*.

Row 3—*Cladosporium herbarum* on strong wheat flour-agar.

Row 4—*Fusarium* sp. on strong wheat flour-agar. *Fusarium* grows much more quickly than *Cladosporium*.

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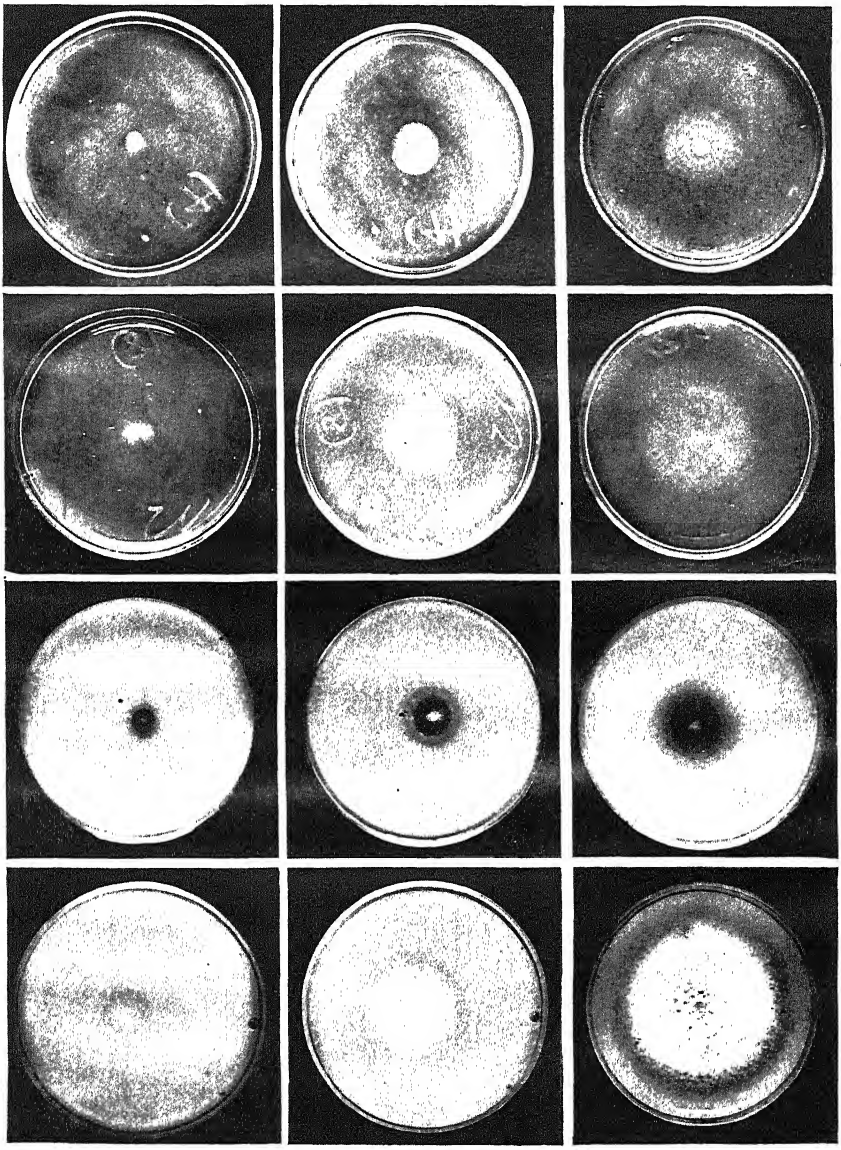

PLATE I.

2—MILDEW IN COTTON GOODS

THE GROWTH OF MOULD FUNGI ON STEEPED WHEAT FLOUR

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Summary

1—The earlier literature dealing with the effect of steeping upon wheat flour is briefly reviewed.

2—A description is given of experiments involving the growth of eight species of mould fungi upon hard (=strong) and soft (=weak) wheat flours which had been steeped for different periods. All the species were isolated from cotton goods mildewed under industrial conditions.

3—The results as a whole support the general opinion that a period of fermentation decreases the liability of the flour to develop mildew, but they also emphasise a point which is not generally recognised.

Considerable specific differences exist between the various mildew-producing fungi, that is to say, under the same conditions some species behave in a markedly different way from others. For example, as the length of the steeping period is increased, the growth of *Cladosporium*, a not infrequent infection of sized warps, and *Fusarium* is increasingly checked. In other words, steeping decreases the liability to mildew so far as these fungi are concerned. On the other hand, it has little or no effect upon the growth of *Aspergillus* and *Penicillium*, which are responsible for the greater proportion of cases of mildew trouble in sized goods. If these fungi alone were considered, therefore it would appear as though steeping had no effect on liability to mildew.

4—These specific differences are also revealed when the flours are steeped with the addition of 6% zinc chloride, which decreases the liability, but much less so with some species than others. For example, the relative checking of growth of *Aspergillus flavus* is only one seventh of that of *Cladosporium*. In this case the liability does not alter with the duration of steeping.

5—The addition of caustic soda to the steep until this is neutral to litmus increases the liability, which is unaffected by the length of the steeping period.

6—If the steeped flour is washed free of acids, the liability is increased, but to a less extent than by neutralisation. Again, the length of steeping has no effect.

7—The effect produced by adding zinc chloride to the steep is also removed by washing.

8—The chemistry of the products of fermentation is discussed in relation to the growth of mould fungi.

INTRODUCTION

The relation of the growth of the mould fungi commonly occurring in cotton goods to some of the different substances employed as adhesives in sizing and finishing has been discussed in a previous communication.[7] Amongst the materials considered therein were hard and soft wheat flours, but both were investigated in the unsteeped condition, whereas it is the usual practice in the industry to subject them to a period of steeping preliminary to their use in sizing. The investigation of steeping, complicated as it is by the effect of time and the possibility of subsequent treatment, such as washing, proved so extensive, however, that it was judged advisable to deal with it in a separate paper, and to confine the previous one to an account of raw materials only.

The preliminary steeping may be carried out for different lengths of time, and to the steeped flour antiseptics may or may not be added; if not, fermentation occurs. The object of steeping is two-fold; first, the flour is

improved from the sizing point of view, and, secondly, it is considered that the liability to develop mildew damage of the goods sized with steeped wheat flour is lessened. The purpose of the present paper is to examine this second aspect of the matter alone.

Summary of Earlier Work.

The earlier writers, Thomson,[11] and Davis, Dreyfus, and Holland,[4] describe the changes which occur during the fermentation of wheat flour, but although their accounts agree in general, a certain number of ideas now obsolete are involved, and it seems desirable to accept the later and, chemically, more complete investigation of Stocks[9,10] as more likely to give a true picture of the process. Consequently the following description is based mainly on these more recent accounts.

The wheat flour, which is composed of starch, nitrogenous substances (usually included in the term gluten), sugar, cellulose, and other cell residues, and mineral salts, is mixed with water and left exposed to the atmosphere with its multitude of floating spores of fungi, yeasts, and bacteria. Some of these settle in the steeping beck and forthwith commence to grow. The first noticeable change is the development of frothing, which causes a considerable increase in the bulk of the contents of the beck, especially in hot weather. This is due to the action of a yeast on the sugars in solution, which are broken down with the production of carbon dioxide (the escape of which causes the frothing), alcohol, and a little glycerol.

After a few days, a distinct fruity odour is noticeable, owing to the formation of ethyl acetate and butyrate from the alcohol by the action of bacteria, which finally produce the free acids from their esters. Another type of bacterium is responsible for the formation of lactic acid directly from the sugars. After this the fermentation settles down and the acids accumulate, less alcohol and carbon dioxide being produced as the yeast loses its activity, partly owing to the inhibitory action of the substances which it has itself produced.

The gluten suffers but little chemical change. It becomes dispersed and forms a colloidal solution in the acids, which also, by virtue of their antiseptic properties[9,10] protect it from the attacks of putrefactive bacteria. Amongst other nitrogenous compounds present in the flour are amino-acids, and it seems probable that these are broken down with the production of various alcohols, for example, amyl alcohol, as in other cases of fermentation by yeast.[6] The small quantity of succinic acid produced (which Stocks[9] ascribes in origin to the sugar) is also probably derived from the same source.[6]

The residues of cellular tissues are broken down to more soluble or diffusible carbohydrates thus setting the starch free, but this itself is scarcely affected unless the fermentation is unduly prolonged when it is broken down to dextrin and sugars, which may then undergo changes similar to those of the sugars originally present in the flour.

Before considering Thomson's[11] remarks on the effects of the products of fermentation on the growth of mould fungi, it may be as well to prefix the warning that he does not make quite clear the two separate ways in which the acids produced may act in this direction. The first is by virtue of their properties as antiseptic substances which inhibit growth if present in sufficiently high concentration. Secondly, as acids, they increase the hydrogen ion concentration of the steep, and so render it more favourable for the growth of many species of fungi, which prefer a somewhat acid to a neutral

medium, and may not be susceptible to the antiseptic action of these compounds in the low concentrations which are yet sufficient to increase the acidity.

Thomson[11] says that the lactic and other acids produced during fermentation have a powerfully poisonous effect upon fungus or "mildew" growths, but he suggests that sufficient of these substances to prevent growth is not produced unless the steeping is carried on for two months. Further, to utilise these antiseptic properties, he emphasises the fact that the whole of the flour and liquor must be used together without washing, as the substances in question are soluble in water and would be removed by such treatment. Thomson goes on to say that as free acid has a powerful effect in aiding the growth of mildew, enough antiseptic must be produced to counteract the tendency to mildew which the free acid gives to the flour, and this tendency is lessened still more by neutralising the greater part of the free acid by the addition of soda ash or milk of lime. (But see p. T36.)

Thomson also quotes an experiment in which pastes made by boiling fermented flour (with its liquor) with water were exposed to atmospheric infection by mould fungi. On flour which had been fermented for only two weeks dense growth occurred in one week, whereas on flour fermented for two months none took place in six weeks. If, however, the flour which had been steeped for two months was washed with cold water till free from acid before making the paste, growth appeared in one week. Thomson concludes that "the small liability of fermented flour to mildew is dependent, not nearly so much on the destruction or transformation of the gluten and other nitrogenous constituents of the flour, as on the antiseptic properties of the substances into which these bodies are transformed."

In view of the indefinite and scanty character of this evidence it seemed desirable to conduct a systematic investigation of the effects of steeping on the liability of wheat flour, using the methods which have already proved useful with the simple substances used in sizing as already described.[7]

EXPERIMENTAL

Media.

Two kinds of wheat flour were employed in the present investigations. Both were commercial mixtures of hard (=strong) and soft (=weak) wheats as ordinarily supplied to manufacturers for sizing purposes.[7]

Samples of these weighing 100 grms. were steeped with water in flasks, fresh batches being started at intervals so that finally series were obtained 1, 3, 6, and 10 weeks old for the soft wheat, and 2, 8, 13, 17, and 18 for the hard wheat flour. The flasks were shaken at frequent intervals through the day to produce the mixing obtained in practice in the becks. The first few batches of 100 grms. of flour were steeped with 200 cc. of water, but, for the later ones, only 100 cc. were employed. This is nearer to the trade proportions and gives a more even mixture with less danger of the flour settling out and caking between the times of shaking. These first batches became the 10 weeks' steep for the soft wheat series, and the 17 and 18 weeks for the hard wheat series, and were included with the others as it was thought that the progress of fermentation would be but little affected. The results obtained show that this assumption was justifiable.

In the case of the soft wheat flour, samples were also steeped with 6 grms. of solid zinc chloride to the 100 grms. of flour. This is lower than the quantity recommended by Bean and Scarisbrick[1] (8%), but allows some growth to

occur in the media as used, and so permits a comparison to be made between the flours steeped for different periods which would not be possible were growth inhibited entirely.

At the end of the period of steeping, each batch was thoroughly mixed and its volume measured in a graduated cylinder so that quantities containing a definite weight of the original flour could be used as required in making up the culture media. Two types of these were employed—size paste and agar jelly—as described previously.[7]

The batches of soft wheat were diluted with water until 1 grm. of original flour was contained in 5 cc. of the mixture. For the size paste 25 cc. (=5 grms. flour) of the diluted steep were poured into 90 cc. of boiling water and boiled gently for five minutes. The resultant thin paste was tubed and sterilised in the usual way. The agar was made up by pouring 20 cc. (=4 grms. flour) of the diluted steep into a hot solution of 4 grms. of agar in 200 cc. of water and boiling. The subsequent treatment was as usual.

In the second series, with hard wheat flour, rather different quantities were used. A stiffer paste (approximately 8%) was obtained by pouring 40 cc. of diluted steep (=8 grms. of flour) into 80 cc. of boiling water, and boiling the whole as before. These proportions prevented the occurrence of a certain amount of settling out, as with the longer period soft wheat steeps, and also gave a somewhat higher concentration of the products of fermentation.

The failure of the agar to set, owing to the acidity of the batches of soft wheat flour which were fermented for long periods, was remedied in this series by increasing the quantity of agar from 2 to 3%, the same proportion of flour being still employed.

Controls were made up with unsteeped flour, which was ground with five times its weight of cold water (that is, the proportions of the diluted steep), and then poured into the agar or boiling water in the same way as the steeped batches.

Other portions of the fermented flour were filtered from their liquor in Büchner funnels at a filter pump, and then washed with cold water until the washings were no longer acid to litmus paper. The flour was then gently dried on the filter paper in an oven, removed from the paper and ground with the requisite quantity of cold water, and made up to size paste and agar jelly in the same proportions as the unwashed samples. The fresh unsteeped flour was first shaken up with water and then filtered and washed. As the soft wheat was not initially acid to litmus, the washing was carried on for a time about equal to that required to free the steeped samples from acid, to make it comparable with these by the removal of other soluble substances, such as sugars.

Considerable experimental difficulties were experienced with the hard wheat. With the 4 grms. to be used with the agar, filtering was very slow, and on drying it was not possible to separate all the flour from the filter paper without including fragments of the latter as well. As, however, paper is not available for the nutrition of the common mould fungi used, the small quantities of it which were ground up with the flour should not have affected their growth rate. The larger quantity (8 grms.) of flour to be made into the size paste could not be sucked free of its original washing water, even after a day on the pump, and as an alundum cone proved equally inadequate, the unsteeped size control had to be abandoned.

A further set of preparations was made by taking some of the diluted steep and making it neutral to litmus by the addition of a few drops of a solution of caustic soda, stirring well, and then using the same quantities as before in making up the size paste and agar media. The fresh flour was shaken up with water (1 grm. in 5 cc. as before), and then treated similarly.

The soft wheat flour which had been steeped with zinc chloride was used in the same way as the fermented flour, one batch also being filtered and washed till acid free.

The Fungi.

The seven species of fungi of the previous experiments[7] were again employed, with the addition of another species of *Aspergillus* in the hard wheat series. This was a greyish-green species isolated from mildewed grey cloth.

A complete list of the species used follows below—

1—*Penicillium* sp. 2.
2—*Penicillium* sp. 4.
3—*Aspergillus niger.*
4—*Aspergillus flavus.*
5—*Aspergillus* sp. 45.
6—*Rhizopus arrhizus.*
7—*Cladosporium herbarum.*
8—*Fusarium* sp.

As before, the tubes of size were inoculated in pairs with spores of the various fungi and incubated at 25° C. Development of growth and sporing was observed at one or two day intervals. The growth rates on agar of *Penicillium 2, Aspergillus flavus, Cladosporium,* and *Fusarium* were determined as in the previous work[7] (p. T11).

Results.

Soft Wheat Flour. Size Paste Cultures—The amount of growth and sporing observed on the size cultures was classified as before[7] into six groups—

0=No growth.
1=Growth but no sporing.
2=First sign of sporing.
3=Sporing definite but slight.
4=Sporing well advanced.
5=Sporing fully developed.

On this basis, the higher the group number the greater is the liability to mildew of the substance on which the fungus is growing.

As the tables obtained are similar to those given in the previous paper,[7] it is not necessary to set them out in full, and only the totals, obtained for all the fungi together, are shown. Following the previous plan, the time which elapses between inoculation of a paste and the first appearance of sporing of the fungus on it can be taken as a measure of the liability of the substance—the shorter the time the greater is the liability. The totals of the times taken by the seven species of fungus together are set out in Table I.

Table I.

Time of Appearance of Sporing in Days. Totals for 7 Fungi

Length of Steeping, in weeks	0	1	3	6	10
Fermented	25	41+	44	52+	56+
Fermented and neutralised	21	22	22	21	18
Fermented and washed	32	61	36	41	41
Steeped with zinc chloride	96+	96+	—	96+	—
Steeped with zinc chloride and washed	—	—	—	89+	—

The above figures may be examined from two aspects. In the first place they show the effect of increasing times of steeping on each treatment, and, secondly, they permit of a comparison of the results of these treatments at intervals in the progress of steeping.

Adopting the first viewpoint, it is seen quite clearly that a much greater period elapses before sporing appeared on the longer than on the shorter period steeps, that is, in the absence of any further treatment the liability of soft wheat flour decreases steadily as fermentation proceeds. After neutralisation, however, this progressive difference disappears and the flours fermented for all periods become approximately equal in liability. The results obtained with the washed samples were irregular but showed a slight tendency for the time of appearance of sporing to increase with length of fermentation. In the case of the cultures with zinc chloride, *Aspergillus flavus* alone of the seven species had commenced sporing before the conclusion of the experiment, and this showed no variation with length of steeping.

Viewed from the second standpoint, the results show that neutralisation annuls the effect of increased time of fermentation and brings the flours of all periods to the same level of liability—which is very slightly greater than that of the unsteeped flour, and much greater than that of the flour which has been fermented for ten weeks. Washing also increases the liability of the flour of the longer periods of fermentation, though not to the same extent as neutralisation, but decreases that of the unsteeped flour and the flour steeped for one week. The liability of the flour steeped for six weeks with zinc chloride is also increased by washing.

Another comparison may be made from the same series of size paste cultures based on the degree of growth achieved by the various species of fungi (here considered together) after the lapse of any particular period of time. Cultures ten days old have been selected in this case and the group totals for this age are given in Table II.

Table II.

Classification of Growth—10 day totals for 7 Species

Length of Steeping, in weeks ...	0	1	3	6	10
Fermented	32	30	27	25	24
Fermented and neutralised ...	35	35	34	34	34
Fermented and washed	28	19	23	22	18
Steeped with zinc chloride ...	4	4	—	3	—
Steeped with zinc chloride and washed	—	—	—	9	—

Except for the effects of washing, this table gives the same results as the preceding one, and these may conveniently be classified as follows—

Length of Steeping—

1—Untreated ... Growth is progressively retarded.
2—Neutralised ... Growth on all periods is equal.
3—Washed ... ... There is a slight tendency towards decreased growth with prolonged steeping.
4—Zinc chloride ... No change in rate of growth.

Effect of Treatment—

1—Neutralisation ... Growth increased.
2—Washing ... ... Growth decreased slightly.
3—Zinc chloride ... Growth almost prevented.
4—Washing after zinc chloride... ... Growth increased.

As essentially similar results were given at other ages of the cultures, there is no need to consider these further here. One point, however, does need consideration in more detail, and that is the different behaviour of the

various species of fungi on flour fermented for various periods. Table III. shows the group numbers of the individual species, which are collected as totals in the first line of Table II. It is seen that the decrease in the totals as steeping proceeded was due to *Cladosporium* and *Fusarium* only; if these are omitted the totals become equal.

Table III.

Classification of Growth at 10 days on Steeped Wheat Pastes

Length of Steeping, in weeks	0	1	3	6	10
Penicillium 2	5	5	5	5	5
Penicillium 4	5	5	5	5	5
Aspergillus niger	5	5	5	5	4
Aspergillus flavus	5	5	5	5	5
Rhizopus arrhizus	4	5	5	5	5
Cladosporium herbarum	4	1	1	0	0
Fusarium sp.	4	4	1	0	0
Totals—7 species	32	30	27	25	24
Totals—first 5 species only	24	25	25	25	24

This necessitates a modification of the conclusions which appeared to be warranted from the previous tables, for it is now seen that so far as *Aspergillus* and *Penicillium* are concerned fermentation has no effect whatsoever; and these are perhaps the most troublesome fungi encountered in sized goods. Considering *Cladosporium* and *Fusarium* only, it is seen that fermentation produces a material on which these fungi find it difficult or even impossible to grow.

Examples of such specific behaviour of mould fungi have been frequently encountered, and naturally this makes the question of their collective treatment extraordinarily complicated.[2]

Soft Wheat Flour. Agar Cultures—The growth rates of four species of fungi on agar jelly were determined as before.[7] The mean diameters of four colonies when five days old are given in Table IV. for *Penicillium* 2. They are also plotted in Figure 1.

Table IV.

Mean Diameter in mms. of 5 day Colonies of *Penicillium* 2

Length of Steeping (weeks)	0	1	3	6	10
Fermented	21	27	25	23	22
Fermented and neutralised	21	23	18	23	25
Fermented and washed	24	21	22	25	22
Steeped with zinc chloride	14	13	—	11	—
Steeped with zinc chloride and washed	—	—	—	20	—

The rate of growth on the fermented flour varied but little with length of steeping. There was a slight increase over the control at one week, and then a gentle fall again to the ten weeks' steep, but this was not sufficiently great to provide definite evidence. Thus the results agree with those of the size cultures for this fungus. Length of steeping also had little effect on the flour neutralised or washed after fermentation or steeped with zinc chloride. (The low figure 18 for the sample which had been steeped for three weeks and then neutralised was due no doubt to the somewhat greater alkalinity of this than the other media.) Neutralisation and washing did not appear to affect the growth rate, but a considerable degree of inhibition was produced by steeping with zinc chloride; an effect which was removed by washing.

Aspergillus flavus was also grown on agar and the results for this species are appended in Table V.

Table V.

Mean Diameters in mms. of 5 day Colonies of *Aspergillus flavus*

Length of Steeping (weeks)	0	1	3	6	10
Fermented	35	39	36	30	24
Fermented and neutralised	34	38	36	33	39
Fermented and washed	36	35	38	36	36
Steeped with zinc chloride	32	32	—	32	—
Steeped with zinc chloride and washed	—	—	—	35	—

As with *Penicillium*, there was a slight initial increase in growth with one week's steeping, but the subsequent fall with the progress of fermentation was quite definite. Again, on the neutralised and washed flours, the growth rates were nearly the same and showed no change with length of steeping. This means that both of these treatments had removed the inhibitory factors which decreased growth of *Aspergillus flavus* on the fermented flour. The effect of zinc chloride on *Aspergillus flavus* was very much less than with *Penicillum* 2, the decrease in size of colony at five days being only about 4 mm. in 36 mm., as compared with 10 in 23 in the latter species. Even so, this slight effect was removed by washing.

Table VI.

Mean Diameter in mms. of 5 day Colonies of *Cladosporium herbarum*

Length of Steeping (weeks)	0	1	3	6	10
Fermented	23	22	22	16	6
Fermented and neutralised	22	21	17	20	21
Fermented and washed	23	22	21	21	20
Steeped with zinc chloride	3	3	—	2	—
Steeped with zinc chloride and washed	—	—	—	20	—

The dimensions given in Table VI. of *Cladosporium* colonies show that less growth occurred as the period of fermentation was lengthened, the decrease being most marked after three weeks, but as with *Aspergillus flavus*, this inhibition was counteracted by neutralisation or washing. The effect of zinc chloride was much greater than with the other species, but this also showed no change with time and was removed by washing.

The fourth species grown in agar cultures behaved in the same way. The marked decrease in growth produced by fermentation was removed by neutralisation or washing, growth after the former treatment being rather greater than on the unsteeped control, or washed flour. These results are set out in Table VII. and shown graphically in Figure 2.

Table VII.

Mean Diameter in mms. of 5 day Colonies of *Fusarium* sp.

Length of Steeping (weeks)	0	1	3	6	10
Fermented	51	42	44	37	—
Fermented and neutralised	54	59	59	60	53
Fermented and washed	51	48	51	46	48
Steeped with zinc chloride	34	31	—	34	—
Steeped with zinc chloride and washed	—	—	—	48	—

In order to gain a general idea of the influence of steeping and subsequent treatment unconfused by the inter-specific differences displayed by the fungi, the colony diameters of all four species are added together in Table VIII.

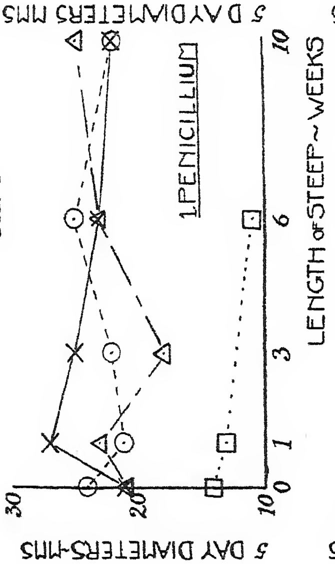

Fig. 1

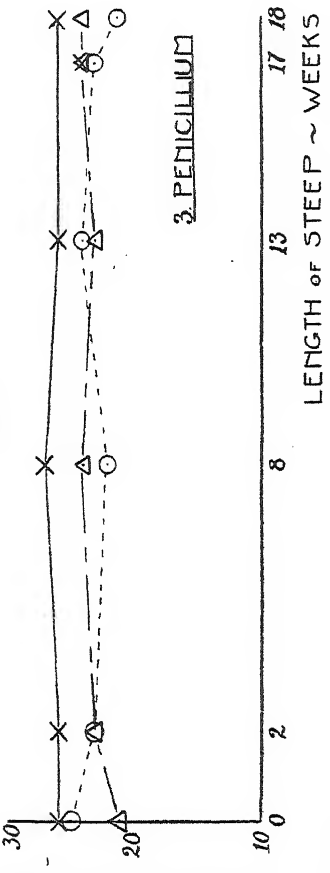

Fig. 2

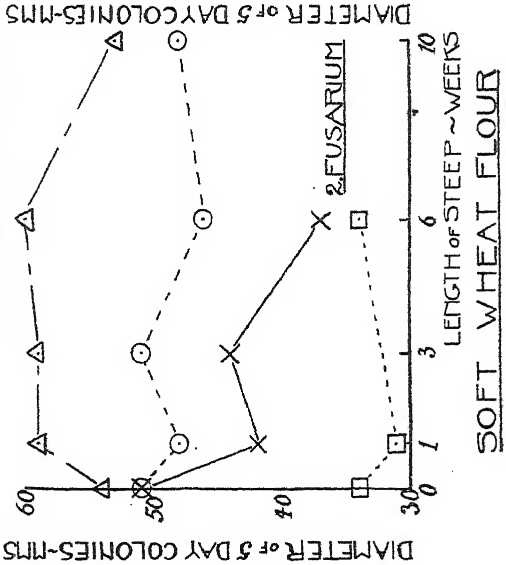

Fig. 3

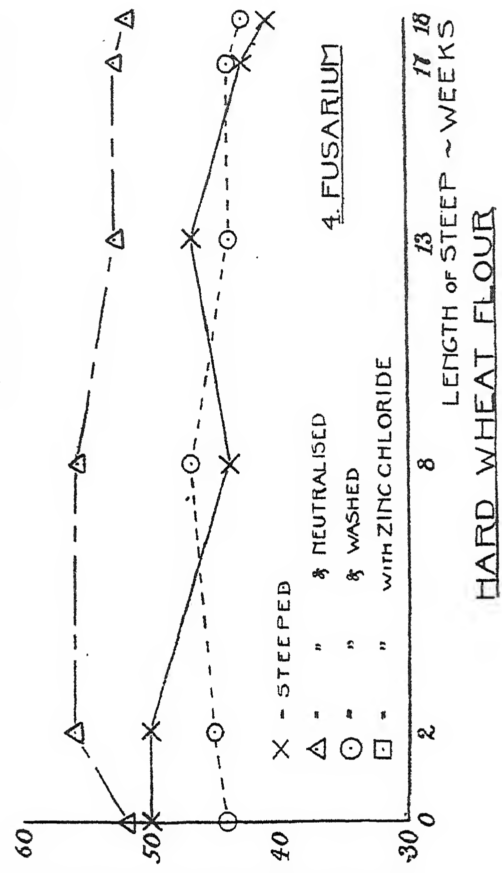

Fig. 4

Table VIII.

Totals of 5 day Diameters of Colonies of Four Species

Length of Steeping	0	1	3	6	10
Fermented	130	130	127	106	89*
Fermented and neutralised	131	141	130	136	138
Fermented and washed	134	126	132	128	126
Steeped with zinc chloride	83	79	—	79	—
Steeped with zinc chloride and washed	—	—	—	123	—

* The figure for *Fusarium* included in this total is taken as 37, *i.e.*, the same as for six weeks. It probably should be lower than this.

This table of totals, which takes all the four fungi into consideration, shows that after the first week prolongation of fermentation produced a decrease in the liability of the flour to fungal growth. This effect was removed by neutralisation with caustic soda, the growth occurring on the fermented and neutralised flour being even greater than on the control fresh flour. Washing with cold water also removed this inhibition, the resulting colonies being about equal in size to those on the unsteeped unwashed control. The growth rate of the mould fungi on the fermented flour subjected to either of these treatments showed no dependence on the length of steeping, the variations in each case probably being within the limits of accuracy obtainable by the experimental methods. Steeping with zinc chloride caused a considerable reduction of growth, but there were marked variations between the different species of fungi in this respect. Thus, with *Cladosporium*, growth on the zinc chloride preparation was only about one-eighth of that on the fresh control, whereas with *Aspergillus flavus* it was about seven-eighths. In all cases, however, the effect of time of steeping was inappreciable.

These results may be summarised as follows—

1—Fermentation ... Growth is progressively retarded with increased length of steeping.

2—Neutralisation ... Growth is increased above the control. There is no appreciable time effect.

3—Washing ... Growth is increased from the fermented to about control level. There is no appreciable time effect.

4—Steeping with zinc chloride causes considerable diminution of growth without change with time. The effect is removed by washing.

Hard Wheat Series—In this series the procedure was as before, except for the increased concentration of the size paste and the lengths of the steeping periods. The results are classified in Table IX.

On fermented flours which had not been washed or neutralised, the rate at which sporing occurred was again found to be greatest on the flour which had been steeped for two weeks, and to be approximately equal on the others. On all the neutralised pastes, sporing was earlier than on the untreated or washed samples.

The classification of growth and sporing at four days shows a marked increase from the unsteeped to the two weeks' fermented, and then a tendency to fall off as the steeping period lengthens. The seven-day totals agree in this respect, but the fall from 2 to 18 weeks is much less, the growth at 17 and 18 weeks being equal to that on the unfermented flour. The different times of steeping with neutralised and washed flour give almost equal growth at both four and seven days, that on the neutralised being greater than on

Table IX.

I.—Time of Appearance of Sporing—8 Fungi

	Untreated						Neutralised						Washed					
Weeks steep ...	0	2	8	13	17	18	0	2	8	13	17	18	0	2	8	13	17	18
Totals ...	34+	23	35+	30+	36+	35+	25	22	22	24	26	27	—	27+	26	26	24	27

II.—Classification of Growth and Sporing—8 Fungi

Four Day Totals ...	22	33	21	23	17	19	30	34	32	29	31	31	—	22	22	22	24	23
Seven Day Totals ...	29	37	30	33	29	31	37	37	38	38	38	38	—	27	28	27	30	28

III.—Growth on Agar—Diameters of 5 day Colonies

Penicillium 2 ...	26	26	27	26	24	26	21	23	24	23	24	24	25	23	22	24	23	21
Aspergillus flavus ...	39	39	35	34	33	33	35	37	37	35	37	37	38	38	38	38	37	35
Cladosporium ...	22	22	19	20	15	15	20	18	20	18	20	20	23	21	20	21	21	21
Fusarium ...	50	50	44	47	43	41	52	56	56	53	53	52	44	45	47	44	44	43
	137	137	125	127	115	115	128	134	137	129	134	133	130	127	127	127	125	120

the untreated. The amount of growth on the washed was less than on the untreated at seven days for all periods of steep, but at first it was equal for the 8 and 13 weeks and greater for the 17 and 18 weeks' samples.

The totals of the diameters of five day old colonies of the four species grown on agar showed a tendency to decrease with increased time of fermentation on the untreated flour. On the washed they were almost equal with a possible fall at the end. The variations in the growth on the neutralised flour were rather greater than on the washed, but showed no general trend and were probably not significant. With the shorter steeping periods (0–2 weeks), growth was greatest at first on the untreated flour, but fell below that on the corresponding washed samples on which in turn growth was less than on the neutralised.

As in the soft wheat series, the effect of length of fermentation on the growth totals was not produced jointly by all the species grown. For example, *Penicillium* was unaffected, while *Fusarium* showed a marked falling off in growth with prolongation of the fermentation period. This varied behaviour can easily be deduced from the sections of Table IX. and from the examples given in Figures 3 and 4 without repeating the rather prolonged detailed analysis of the tables as was done for the soft wheat series.

Comparison of Hard and Soft Wheat Flours—For both hard and soft wheats, all the methods of comparison agree in showing a greater growth on the neutralised flour, but in each case the media were still very slightly acid (*p*H 6·0), and a further addition of caustic soda might have reduced this growth. (In this connection, see the discussion of the rôle of added alkali on p. T36.)

The untreated flour in both cases showed a tendency for growth to decrease with increasing length of steep, this being more marked with the soft than the hard wheat, in which there was an initial increase in growth with the first two weeks of fermentation.

The relation between growth on the untreated and washed media varies. With the soft wheat the classification of growth on size gives predominance to the untreated, but the time of appearance of sporing and the total growth rates reverse this relation, especially with the longer periods of steeping. This is so also with the size classification on the hard wheat flour, but the time of appearance of sporing gives the washed material a position intermediate between the neutralised and untreated.

Comparison with Starches.

Besides the consideration of the effect of fermentation on wheat flour itself, it is desirable for practical purposes to compare the liabilities of the steeped and treated products with that of untreated starches, such as maize, farina, or sago. The results of experiments on the growth of mould fungi on such substances are collected together in Table XVI. of the preceding paper, which can now be extended to include the results with fermented wheat flour. The figures obtained for the unsteeped flours in the present series agree well with those obtained before, and so a direct comparison can be made (Table X.). As before, a low number of days between inoculation and the appearance of sporing, and a high figure for growth and sporing on size and for growth on agar, indicate a high liability to develop mildew growth, and *vice versa*.

Consideration of these together gives the grouping in the last column of the table, the substances in Group 1 being more liable than those in

Group 2, and these than the members of Group 3. The grouping is only approximate, and considerable differences in degree of liability occur among the substances in one group; for example, unfermented hard wheat flour comes in the same group as hard wheat flour which has been fermented for 13 weeks, although the former is definitely more liable, as shown in Table IX., but, compared with substances such as maize starch or farina, they are both very liable to mildew growth. For comparison with starches other than those given here, Table X. may be used as a direct extension of Table XVI. of the preceding memoir.

Table X.

Grouping of Substances by Degree of Liability

Substance	Treatment	No. of days between Inoculation and Sporing (7 species)	Growth and Sporing on Size in 9 days (7 species)	Growth on Agar in 5 days (4 species)	Group Number
Soft Wheat Flour	... ...	22	33	130	1
	10 weeks fermented	56+	24	89−	3
	Ditto and neutralised	18	34	138	1
	Ditto and washed	41	18	126	2
Hard Wheat Flour	... ...	25	33	138	1
	13 weeks fermented	24	30	127	1
	Ditto and neutralised	20	33	129	1
	Ditto and washed	23	24	127	2
Maize Starch	... ...	44	19	120	2
Farina ...	... ...	55	13	113	3
Sago ...	... ...	55+	12	113	3

The general results are that ten weeks' fermentation reduces the liability of soft wheat flour to the level of that of farina and sago. Subsequent neutralisation restores the liability to the unfermented flour level, whereas washing leaves the product slightly more liable to fungus growth than maize starch. With hard wheat flour, on the other hand, the results of fermentation are not so marked, the flour after 13 weeks still being more liable than maize starch. A greater concentration of the fermented flour in making up the media probably would have given a greater effect, but even so, the soft wheat would show a larger proportionate reduction in its liability, due to fermentation.

DISCUSSION OF RESULTS

From the chemical changes which take place during the fermentation of wheat flour, it might be expected that corresponding differences would be

found in the amount of fungal growth which the flour will support. The first change results in the destruction of sugar, which, according to Stocks,[9] may be reduced from 3·62% in the fresh flour to only 0·54% after two weeks' steeping, while during the next fortnight it is completely broken down. This, alone, would tend to a slight reduction of liability to mildew during the first three or four weeks' fermentation with no change after that time, but the sugar is not merely removed from the flour—it is replaced by alcohol, esters, and eventually acids, which also affect fungal growth, if only to a small extent. Duggar[5] found that traces of ethyl alcohol caused increased germination of the spores of *Aspergillus*, but Pratt[8] obtained no effect on *Botrytis* with one part of this alcohol to six of a nutrient solution. Thomson in his first edition[11a] gives the results of an experiment in which wheat flour pastes were exposed to atmospheric infection. The addition of 1 and 2·5% alcohol to Egyptian flour had no influence at all on the time which elapsed before mould growth appeared—but he does not state what species of fungi developed.

The effect of the ethyl esters of the organic acids may vary, for Brown[4] has shown that growth of *Botrytis* may be stimulated by dilute solutions of ethyl acetate, but inhibited by the same ester in greater concentration. Pratt[8] has demonstrated that free acetic and butyric acids, even in solutions as dilute as $N/30$, prevent the germination of the same fungus. Lactic acid is less toxic, but has some effect at this concentration, whereas succinic acid has very little. As Stocks's[9] figures indicate that in six weeks' fermentation enough acid is produced to give a normal solution, a considerable diminution in growth might be expected with increasing length of steep. Complete inhibition is not likely for many other species of fungi are in all probability less susceptible to the toxic effect of these substances. It should be noted that this degree of acidity, that is the concentration of hydrogen ions, is not enough to check growth of itself, and in the case of some fungi may even favour it.

The slight reduction in total quantity of albuminoids found by Stocks[9] would not affect the liability, but the increase of the soluble part might be favourable to fungus growth. The changes in the starch and cellulose are probably too small to produce any alteration during the normal period of fermentation.

Washing with water will remove the soluble products from the steeped mixture. The elimination of the acids with their inhibitory properties will be favourable to increased growth, but, on the other hand, nutritive substances, such as the soluble albuminoids, will be removed as well, and the final relation between the untreated and washed fermented flours will be the result of the balance between these factors. That the acid effect is the more important was shown by the decrease of growth which occurred on the longer period untreated steeps, and the roughly constant amounts on the washed samples of all lengths of fermentation period.

If, instead of being washed away, the free acids are neutralised by the addition of alkali, there is no removal of nutritive substances from the flour with consequently decreased growth. The toxic effect of the acids is probably diminished in accordance with the suggestion of Pratt,[8] namely, that the inhibitory action is due to the un-ionised part of the slightly dissociated free acids, the ions of the highly dissociated salts having little or no toxicity. The effect of the addition of caustic soda then will be to increase

the growth possibilities of the steeped flour unless sufficient is added to produce definite alkalinity, when the concentration of hydroxyl ions may be great enough to prevent the occurrence of germination. The attainment of this state varies greatly with different fungi, and is also probably undesirable from the sizing point of view. When caustic soda is added in quantities merely sufficient to produce neutrality to litmus paper, the experiments show that this results in an increase of liability above that of the untreated steeped flour.

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3—THE MOISTURE RELATIONS OF COTTON

THE ABSORPTION OF WATER BY COTTONS OF VARIOUS ORIGINS

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INTRODUCTION AND SUMMARY

The work described in the previous papers of this series[4,5,6,7] has been confined to an examination of the hygroscopic properties of one cotton—American Upland 85R. In view of the number of different cottons in use in the industry it seemed desirable to gain some knowledge of the degree of variability which might be expected to exist among these materials. Schloesing[3] found that Indian cotton was more hygroscopic than Egyptian, and Egyptian more hygroscopic than American, but this result was not confirmed by Naumburg,[2] who showed that Egyptian was very similar to the average American.

The main interest of the present work lies in the numerical data rather than in any conclusions which may be drawn therefrom. It is shown, however, that the differences which are observed among the raw cottons are considerably reduced by the partial purification effected by boiling with water, and hence it is probable that the pure celluloses of these various cottons are only slightly variable, the observed differences being largely attributable to the non-cellulosic impurities. The results differ numerically from those of Naumburg,[2] but agree with them in demonstrating that a knowledge of the hygroscopicity of a cotton is of little avail for the identification of its type.

The examination of a number of variously processed cottons has shown that the removal of non-cellulosic impurities is accompanied by a reduction in hygroscopicity, whilst the dyed material exhibits a further reduction which cannot be wholly explained in terms of the loading of the cotton with non-hygroscopic substances.

The materials used in this investigation are enumerated below—

Series A—Grey Yarns.

A 51, Sea Island.	A 54, Texas.
A 52, Sakel.	A 55, Indian.
A 53, Peruvian.	A 56, Queensland.

Series B—Water-boiled Yarns.

The same yarns as those of Series A, boiled in water for 7 hours at 25 lbs. pressure.

Series C—Texas Yarns.

(*a*) Grey. (*b*) Water-boiled. (*c*) Soda-boiled and bleached.
(*d*) Soda-boiled, mercerised, and basic dyed. (*e*) Water-boiled and basic dyed.

All the treatments mentioned above were carried out technically.

EXPERIMENTAL METHODS AND RESULTS

As comparative rather than absolutely accurate results were desired, the desiccator method[4,7] was used throughout. Two samples of each cotton were placed in weighing-bottles, and dried over phosphorus pentoxide at room temperature. They were then placed in a vacuum desiccator (one series in one desiccator) over a solution of sulphuric acid of concentration necessary to provide an atmosphere of approximately 20% relative humidity. The bottles were weighed weekly until successive weights either were constant or oscillated with small amplitude about a mean value. The acid was then standardised and changed, when the process was repeated at the new humidity. In this way the materials were exposed to atmospheres of (approximately) the following humidities, in the order—Relative humidity, per cent., 20→40→60→80→90→96→100→90→80→60→40→20. The materials were passed through an atmosphere of 100% relative humidity, in order that desorption might take place on the true desorption curve, but no reliable values for the moisture contents at this humidity can be given.

The data obtained for the raw and water-boiled cottons are recorded in Tables I. and II., and graphically reproduced in Figs. 1 and 2. They show that Schloesing's conclusions with regard to the relative hygroscopicities of American, Egyptian, and Indian cottons are not general; the hygroscopicity of a cotton provides no clue either to its origin or to its quality.

The traced curves of Figs. 1 and 2 are merely the boundary curves, and do not necessarily represent the isotherms for any particular cottons. The magnitude of the areas enclosed by these curves is, however, a measure of the variability of the hygroscopicities of these cottons. A comparison of the areas of Fig. 1 with those of Fig. 2 will show that water-boiling has occasioned an appreciable reduction in the variability. A more quantitative comparison may be made by a study of Table III. Here it is seen that the variability coefficients for the raw cottons are considerably greater than those for the water-boiled, except in desorption at low humidities. There the coefficients for the water-boiled cottons are very high, largely owing to the abnormally low values of the moisture content found for the Indian cotton. It seems probable, however, that these low humidity desorption values for the Indian cotton are affected by an unknown error, more particularly as the lowest desorption value is actually less than the corresponding absorption value. It may therefore be concluded that the considerable differences exhibited by the raw cottons are due to the presence of non-cellulosic impurities, the celluloses themselves being very similar whatever their origin.

In Fig. 3 are shown on the same diagram the results for raw and water-boiled Sea Island cotton. The curves for the other cottons are similarly disposed, so that the water content of water-boiled cotton is everywhere less than that of raw cotton at the same humidity. The differences between the two sets of results at a few humidities have been tabulated in Table IV., for which the data were obtained by interpolation on the smooth curves drawn among the experimental points. The figures show that the reduction in hygroscopicity is much greater in desorption than in absorption.

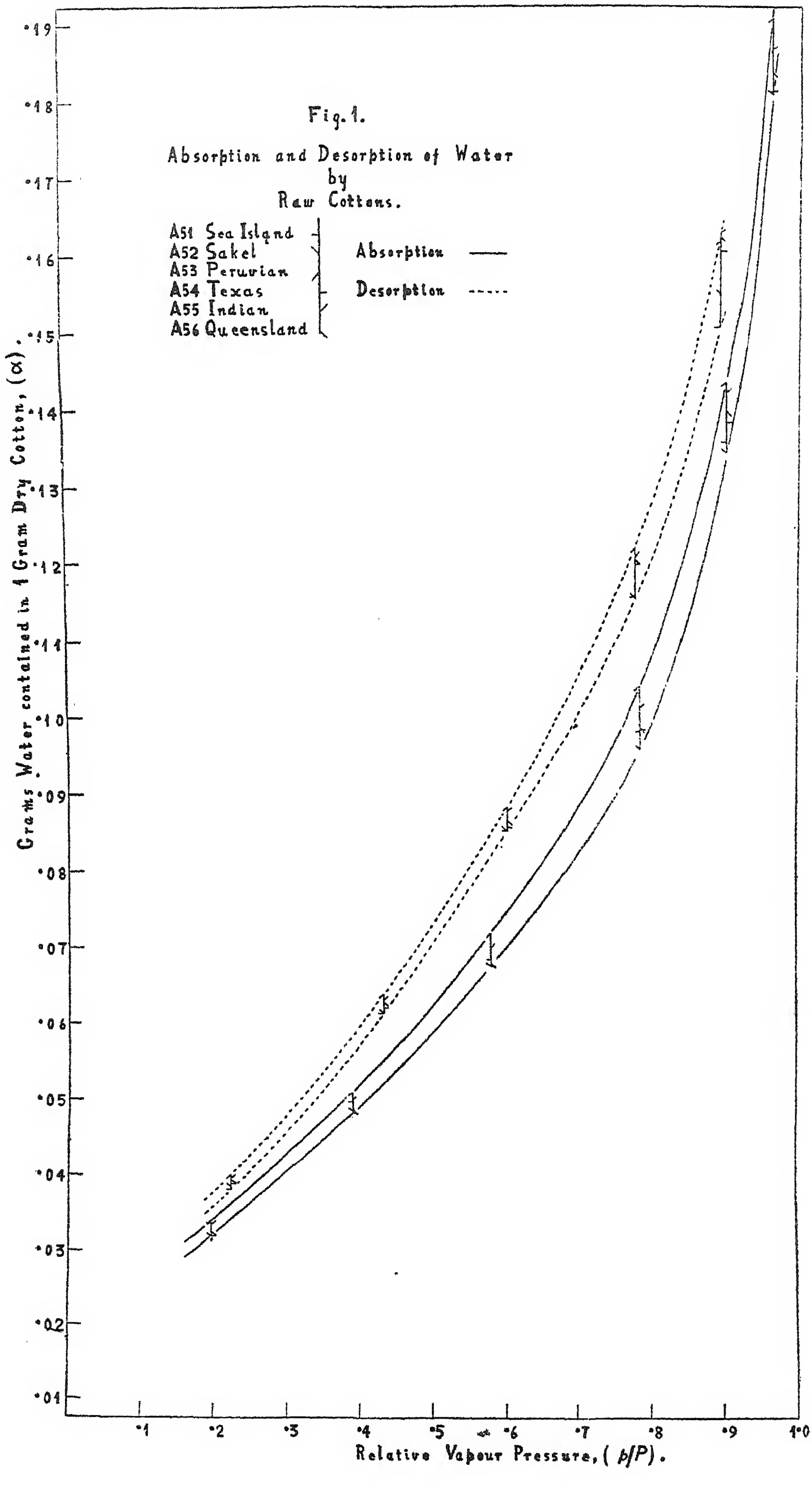


Fig. 1.
Absorption and Desorption of Water by Raw Cottons.
A51 Sea Island
A52 Sakel
A53 Peruvian
A54 Texas
A55 Indian
A56 Queensland
Absorption
Desorption
Grams Water contained in 1 Gram Dry Cotton, (α).
Relative Vapour Pressure, (p/P).
·01 ·02 ·03 ·04 ·05 ·06 ·07 ·08 ·09 ·10 ·11 ·12 ·13 ·14 ·15 ·16 ·17 ·18 ·19
·1 ·2 ·3 ·4 ·5 ·6 ·7 ·8 ·9 1·0

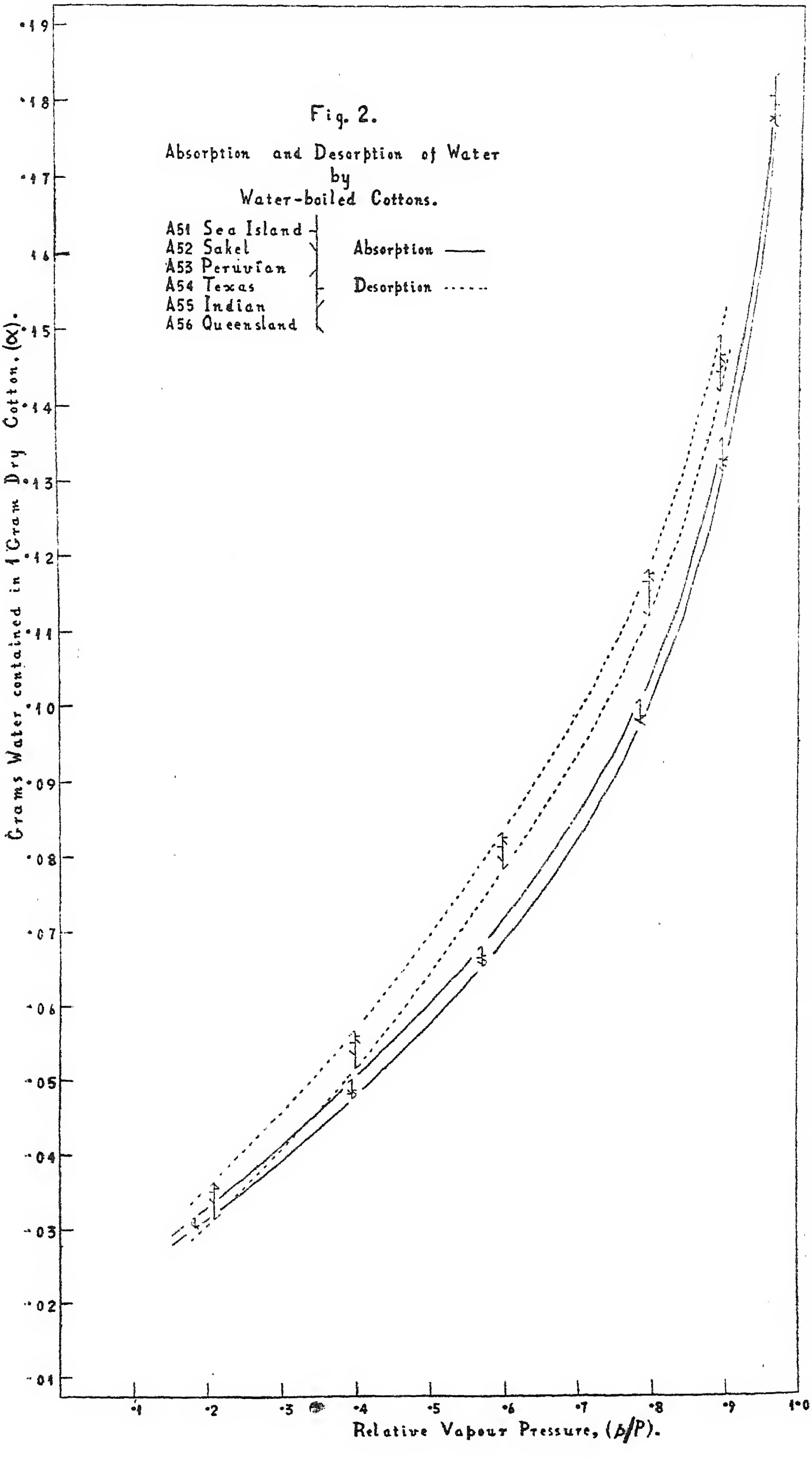


Fig. 2.
Absorption and Desorption of Water by Water-boiled Cottons.
A51 Sea Island
A52 Sakel
A53 Peruvian
A54 Texas
A55 Indian
A56 Queensland
Absorption ——
Desorption ------
Grams Water contained in 1 Gram Dry Cotton, (α).
Relative Vapour Pressure, (p/P).
·19
·18
·17
·16
·15
·14
·13
·12
·11
·10
·09
·08
·07
·06
·05
·04
·03
·02
·01
·1
·2
·3
·4
·5
·6
·7
·8
·9
1·0

Table I.

Absorption and Desorption of Water by Series A, Raw Cottons

Relative Vapour Pressure p/P	Grams Water contained in 1 gram Dry Cotton α					
	A 51 Sea Island	A 52 Sakel	A 53 Peruvian	A 54 Texas	A 55 Indian	A 56 Queensland
			Absorption			
·195	·0337	·0321	·0341	·0321	·0336	·0326
·386	·0496	·0483	·0509	·0481	·0499	·0486
·576	·0683	·0676	·0719	·0676	·0698	·0679
·784	·0981	·0958	·1042	·0984	·1012	·0986
·902	·1360	·1346	·1436	·1385	·1424	·1400
·962	·1815	·1811	·1909	·1816	·1870	·1838
			Desorption			
·894	·1509	·1554	·1622	·1609	·1633	·1627
·779	·1158	·1157	·1221	·1200	·1210	·1206
·601	·0854	·0854	·0884	·0858	·0879	·0867
·431	·0614	·0614	·0639	·0621	·0632	·0627
·221	·0381	·0385	·0401	·0389	·0396	·0394

Table II.

Absorption and Desorption of Water by Series B, Water-boiled Cottons

Relative Vapour Pressure p/P	Grams Water contained in 1 gram Dry Cotton α					
	A 51 Sea Island	A 52 Sakel	A 53 Peruvian	A 54 Texas	A 55 Indian	A 56 Queensland
			Absorption			
·183	·0311	·0305	·0318	·0306	·0303	·0307
·394	·0484	·0484	·0504	·0489	·0478	·0488
·570	·0665	·0656	·0682	·0668	·0653	·0664
·785	·0981	·0976	·1009	·0986	·0982	·0978
·899	·1329	·1313	·1358	·1328	·1326	·1322
·961	·1808	·1777	·1781	·1796	·1833	·1773
			Desorption			
·895	·1444	·1418	·1494	·1466	·1449	·1462
·797	·1165	·1121	·1182	·1176	·1152	·1172
·600	·0814	·0795	·0834	·0826	·0784	·0823
·398	·0553	·0537	·0570	·0562	·0518	·0559
·208	·0352	·0338	·0365	·0356	·0315	·0363

Table III.

Raw Cottons				Water-boiled Cottons			
p/P	Mean Value of α	Standard Deviation	Coefficient of Variability per cent.	p/P	Mean Value of α	Standard Deviation	Coefficient of Variability per cent.
	Absorption				Absorption		
·195	·0330	·0008	2·4	·183	·0308	·0005	1·6
·386	·0492	·0010	2·0	·394	·0488	·0008	1·7
·576	·0689	·0016	2·3	·570	·0665	·0009	1·4
·784	·0994	·0027	2·7	·785	·0985	·0011	1·1
·902	·1392	·0035	2·5	·899	·1329	·0014	1·0
·962	·1843	·0036	1·9	·961	·1795	·0021	1·2
	Desorption				Desorption		
·894	·1592	·0046	2·9	·895	·1456	·0023	1·6
·779	·1192	·0025	2·1	·797	·1161	·0020	1·8
·601	·0866	·0012	1·4	·600	·0813	·0018	2·2
·431	·0625	·0009	1·5	·398	·0550	·0018	3·2
·221	·0391	·0007	1·7	·208	·0348	·0018	5·0

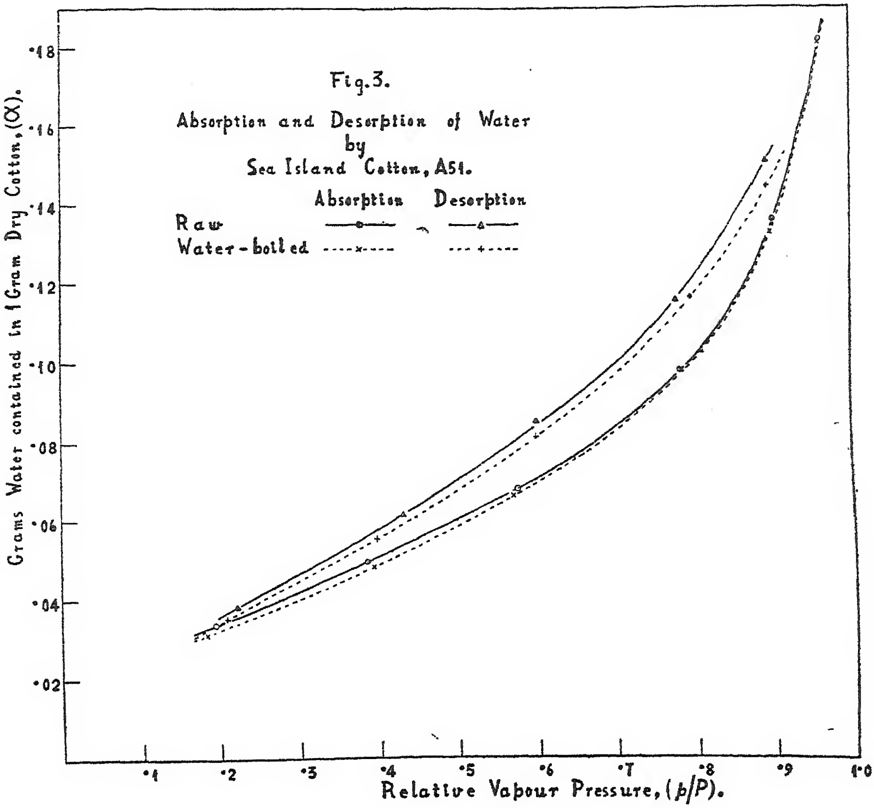


Table IV.

α Raw — α Water-boiled

p/P	A 51 Sea Island		A 52 Sakel		A 53 Peruvian		A 54 Texas		A 55 Indian		A 56 Queensland	
	Abs.	Des.	Abs.	Des.	Abs.	Des.	Abs.	Des.	Abs.	Des.	Abs.	Des.
·2	·002	·002	·001	·003	·001	·002	·001	·002	·002	·005	·002	·002
·4	·002	·002	·001	·004	·002	·003	·001	·003	·002	·007	·002	·004
·6	·002	·006	·002	·005	·004	·005	·001	·004	·003	·011	·002	·005
·8	·002	·004	·001	·008	·004	·008	·002	·007	·003	·011	·002	·008

The data for the variously processed Texas yarns are presented in Table V. and the isotherms reproduced in Fig. 4. Here it is shown that the removal of the impurities from cotton reduces its hygroscopicity, in confirmation of the result previously obtained.[4] The figures for the water-boiled and dyed yarn are of interest in comparison with those for the water-boiled yarn. At low humidities the dyed yarn absorbs very little less water than the undyed, but at high humidities the reduction in hygroscopicity induced by dyeing is considerable. This reduction is too large to be ascribed to the

loading of the cotton with a non-hygroscopic substance. It must be noted, however, that this result has been obtained only for one particular type of dyeing. The evidence is insufficient to show that such behaviour is common to all dyed material.

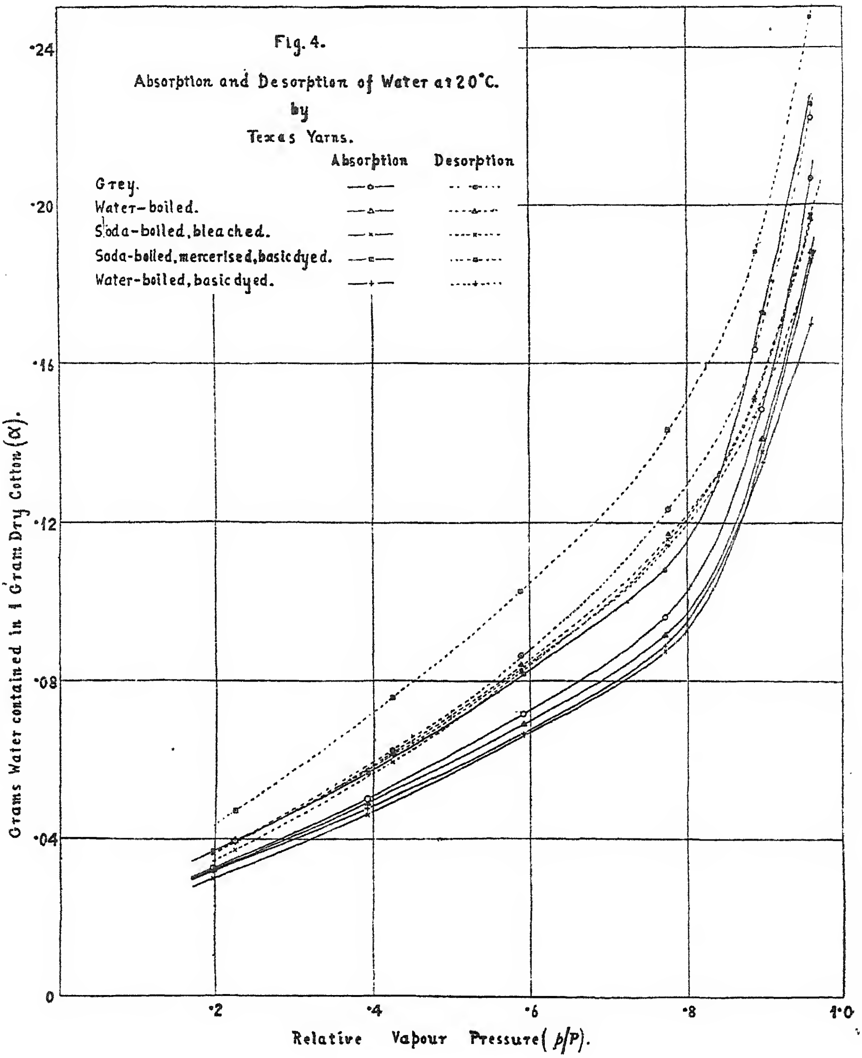
Table V.

Absorption and Desorption of Water by Series C, Texas Yarns

Relative Vapour Pressure p/P	Grams Water contained in 1 gram Dry Cotton α				
	Grey	Water-boiled	Soda-boiled and bleached	Soda-boiled, mercerised, and basic dyed	Water-boiled and basic dyed
			Absorption		
·198	·0327	·0323	·0301	·0370	·0320
·394	·0500	·0491	·0461	·0567	·0478
·591	·0716	·0691	·0659	·0814	·0665
·773	·0959	·0914	·0873	·1081	·0886
·897	·1485	·1410	·1378	·1729	·1353
·959	·2065	·1882	·1863	·2254	·1699
			Desorption		
·958	·2219	·1964	·1971	·2473	·1856
·888	·1634	·1513	·1508	·1883	·1465
·777	·1233	·1171	·1157	·1433	·1141
·588	·0862	·0840	·0821	·1025	·0826
·425	·0622	·0618	·0594	·0759	·0613
·226	·0396	·0400	·0373	·0473	·0399

It will be observed that the figures for the Texas cotton of Series A and B agree with those for the grey and water-boiled Texas yarn of Series C at humidities up to 85%, but that above that humidity they show an appreciable divergence. This may be due to a real difference between the materials, but it is more probable that it is merely an indication of the difficulty of obtaining correct absolute values at high humidities by the desiccator method, a difficulty which may perhaps be attributed to temperature variation, since a small change in temperature produces a change in humidity proportional to the existing humidity, and a small change in humidity at high humidities results in a large change in moisture content. The divergence noted does not, however, affect the comparative accuracy of the data for each series.

The effect of mercerisation has been and will be dealt with elsewhere,[7] so that it is not proposed to discuss the results for the mercerised yarn in any detail, but it will be noted that the mercerisation ratio for this material (1·23) is much less than the ratios previously found (1·44–1·65) for a similar cotton mercerised under different conditions. The material formerly used was mercerised loose, without tension, and brought to air-dry condition at room temperature, whilst that examined in the present work was mercerised in the form of yarn, with tension, and dried by heating. It is well known that heating causes a reduction in the absorptive capacity of cotton,[1,4] and it will be shown in a forthcoming publication that cotton mercerised in yarn form has a mercerisation ratio less than that of cotton mercerised loose, while mercerisation under tension also causes a reduction in the ratio. Since these effects are cumulative it is probable that the mercerisation ratio here found (1·23) is fairly normal for a technically mercerised cotton.



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4—THE CHEMICAL ANALYSIS OF COTTON

THE ASH CONTENT AND ASH ALKALINITY OF TYPICAL COTTONS

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I.—INTRODUCTION AND SUMMARY

Though the amounts of mineral matter in cottons of different origin have been determined by several observers, the figures are, almost without exception, of doubtful value, for the analyses have been made either on cotton from the bale and expressly include contaminating sand and dust, or on lint cottons without, apparently, any precautions to remove adhering impurities. The values given by Davies and Dreyfus[4] (often wrongly ascribed to Matthews), by Monie,[11] and by Mitchell and Prideaux[10], for example, include sand and dust, whilst those of Barnes[1] were determined on lint cottons, and, in the authors' experience, such figures are valid only when the analyses have been made on samples which have been carefully combed by hand, the treatment removing an appreciable amount of sand and dirt, even when the cottons appear to be quite clean. The variations observed by these workers are shown in the following table—

Type of Cotton	Ash (%)			
	Davies and Dreyfus	Monie	Mitchell and Prideaux	Barnes
Sea Island	1·25	1·10	2·2	1·2
American (U.S.) ...	1·5	1·6—2·1	2·0	1·3—1·9
South American ...	1·2—1·7	1·2—2·0	2·1	—
Egyptian	1·2—1·7	1·6—1·8	—	1·4—1·5
Indian	2·5—6·2	2·3—5·3	2·9—3·3	1·3—4·0

The mean figure quoted in Bulletin No. 33 of the United States Department of Agriculture[3] for American cottons (1·65%) is probably open to the same criticism as those of Barnes, which, however, answered the purpose for which they were intended—the proof that the high content of mineral matter in baled Indian cotton was not necessarily due to intentional falsification.

Isolated measurements which appear to exclude extraneous matter have been made by Ure,[13] who found approximately 1% of ash in a carded Sea

Island cotton, by Knecht,[6] who found 0·93% in an American yarn, and 0·89 and 1·17% in two samples of Egyptian yarn, and by Lester,[8] who found 0·82% in an American yarn, values definitely lower than those recorded above, from which the only conclusion to be drawn is that Indian cottons might be found in many cases to contain a significantly greater proportion of mineral constituents than other growths.

Davies and Dreyfus[4] suggested that an excess of ash much over 1% might be ascribed to sand and other impurities, a statement which has been repeated by Matthews and disputed by Barnes.

The procedure for determining mineral matter in cotton has already been standardised by Birtwell, Clibbens, and Ridge,[2] who showed that for many purposes it is preferable to measure instead the alkalinity of the ash, which is roughly proportional to its amount, and thus eliminate errors which are inevitable in the manipulation of small amounts of hygroscopic material. They define *ash alkalinity* as the number of milli-equivalents of acid (*i.e.* ccs. of a normal acid solution) required to neutralise the ash from 100 grms. of clean cotton. In the present work, the results are also expressed in a second form, the *alkalinity per gram of ash,* which is simply the ash alkalinity divided by the ash content. This figure is appreciably constant for different classes of cotton and therefore allows the approximate ash content to be calculated from the ash alkalinity.

Birtwell, Clibbens, and Ridge were interested in the significance of the determinations in the control of bleaching, and as they concluded that they were without value for this purpose, further work remained in abeyance. More recently, however, the determinations have proved useful in the control of the grey sour and other steeping processes. During the course of this work, the ash contents and ash alkalinities of a number of representative American and Egyptian cottons were determined, and the conclusion drawn that the *alkalinity per gram of ash* might add to the chemical methods of differentiating cottons, for the American cottons gave figures between 13 and 14, and the Egyptian cottons figures between 15 and 16, differences quite significant in view of the accuracy with which the determinations could be carried out. The experiments were therefore extended to include cottons of more widely different origins, almost all of which were well authenticated. Some of these were available only in the form of lint cotton, when it was found that reliable measurements were obtained only by carefully hand combing the material to remove adhering sand, &c., as completely as possible. Others were taken at various stages of the spinning process, and had therefore been cleaned mechanically by the machinery.

From the results it is evident that the mineral matter in North American cottons varies normally between 1·1 and 1·3%, the mean value for twelve samples examined being 1·2%. The ash alkalinity of these varied from 14·5 to 18·2. The alkalinity per gram of ash was less variable, for in ten of the twelve samples it was between 13·1 and 14·5, two samples only giving higher figures—15·3 and 15·7 respectively. The mean figure for the whole of the twelve samples was 14·1. The South American cottons examined did not differ greatly from the North American, the ash content varying from 0·8 to 1·35% for seven samples, the ash alkalinity from 10·8 to 19·5, and the alkalinity per gram of ash from 12·8 to 15·3, with a mean value of 14·3. Excluding the sample of Peruvian "moderate rough," for which all three figures were low, the ash contents varied between 1·2 and 1·35%,

the ash alkalinities between 15·2 and 19·5, and the alkalinities per gram of ash between 14·4 and 15·3, with a mean of 14·5. This last figure tended to be higher for the Brazilian than for the Peruvian cottons.

For American cottons obtained from East and South Africa, the Sudan, and Iraq, the figures were rather higher, the ash content varying from 1·2 to 1·8%, the ash alkalinity from 18 to 26, and the alkalinity per gram of ash from 14·5 to 16·0, with a mean of 15·3 for the fifteen samples. The ashes of these cottons were very white and bulky, compared with those of the other samples examined, which were compact and tinged a faint greenish-yellow.

Seven samples of American cottons grown in India gave from 1·0 to 1·5% of ash, the ash alkalinities varying from 15·3 to 22·4, and the alkalinities per gram of ash from 12·4 to 15·7, or, excluding Cambodia, which differed considerably from the others, 14·8 to 15·7, with a mean of 15·3.

For American cottons, therefore, the statement than an ash content "much" over 1% is indicative of the presence of extraneous matter is only valid when outside growths are excluded; these may be distinguished from North and South American samples, to some extent, by their ash contents and alkalinities per gram of ash.

The ash contents of six samples of Egyptian cotton were found to be very similar to those of American growths, varying between 1·1 and 1·3%, with a mean figure of 1·2. The ash alkalinities ranged from 17·3 to 19·0, and the alkalinities per gram of ash from 14·9 to 15·6, with a mean of 15·3, so that the alkalinity of the ash is generally higher for Egyptian cottons than for normal American growths. Two samples of Egyptian origin, grown in North and South America respectively, had alkalinities per gram of ash in close agreement with the mean figure for Egyptian cottons, whilst two samples of Sakel grown in the Sudan had rather higher figures.

Ash contents of about 1·2% and alkalinities per gram of ash of approximately 15·3 are therefore typical for normal Egyptian cottons, the latter figure being, apparently, more constant than for American cottons.

A series of ten native Indian cottons, some of them representative trade samples obtained in Liverpool, and others types which are being propagated by the Indian Central Cotton Committee to replace older growths, were found to contain from 1·0 to 1·6% of mineral matter—much lower figures than have been recorded by previous observers. The ash alkalinities varied between 15·5 and 22·2, and the alkalinities per gram of ash from 13·6 to 16·5, with a mean of 15·1.

It has been shown already that of the four trade samples—Broach, Surtee, Oomra, and Bengal—the Broach and Surtee had much higher phosphorus contents[5] than the Bengal and Oomra, and also higher nitrogen contents,[12] though here the differences were less marked, and, further, that the Oomra and Bengal samples showed the greatest variation from American and Egyptian cottons in the properties of the waxes.[7] Similar differences exist in the ash contents, the Broach and Surtee samples containing from 1·4 to 1·6% of mineral matter, and the Oomra and Bengal approximately 1·1%. These differences may possibly be connected with the botanical origin of the cottons, but it would be unwise to stress them at this stage in view of the uncertain origin of all trade samples.

Six samples of Sea Island cotton gave ash contents varying from 0·7 to 1·2%, the mean value being 1·0%. The ash alkalinities showed a correspondingly wide variation—from 11 to 19—but the alkalinity per gram of ash remained fairly constant, varying only from 14·4 to 15·8, the mean figure being 15·2. Three other samples—one from the Virgin Islands, one from Ceylon, and one from the Gold Coast—are included in the table, but show no point of interest save a tendency for the content of mineral matter to rise and the alkalinity per gram of ash to fall, as compared with the normal samples.

In earlier communications in this series, it has been shown that the amounts of phosphorus,[5] nitrogen,[12] and wax,[7] in the shorter-stapled material removed from card sliver during the process of combing, were greater than those in the combed material, and the same is true for the mineral matter. In the case of the wax the divergence in amount was accompanied by no significant difference in the properties, and in that of the mineral matter the alkalinity per gram of ash remains practically unchanged. This constancy in composition of the ash shows that the variation in the amount is a property of the cotton and is not due to the removal of sand or other extraneous impurities by combing, for in this case the alkalinity per gram of ash might have been expected to show significant variations. It indicates, also, that samples at any stage from the card sliver onwards are practically free from extraneous matter, and therefore give an accurate measure of the ash content of the cotton.

Summarising, therefore, it may be said that the mineral matter in North and South American, Egyptian, and Sea Island cottons usually varies between 1 and 1·3%. Higher figures are sometimes encountered with outside growths of American cotton and with native Indian types, though the differences are much smaller than were anticipated from the results of previous workers. Lower figures are found most often with Sea Island cottons. The alkalinity per gram of ash is a fairly constant factor for different classes of cotton, North and South American varieties being generally characterised by somewhat lower values than outside American, Indian, Egyptian, and Sea Island growths. The observation made previously that the ash alkalinity of a cotton is approximately proportional to its ash content is thus amply confirmed. The mean values given in the text enable the approximate ash content to be calculated from the ash alkalinity; this is especially useful in cases where the amount of material available for examination is small.

II.—EXPERIMENTAL

Ash and Ash Alkalinity Determinations.

The ashing of the cotton was carried out essentially as described by Birtwell, Clibbens, and Ridge; about 5 grms. of the sample under examination, previously dried at 110° C., was ignited gradually before an electrically heated muffle furnace, and the ashing completed at a dull red heat, corresponding to a definite current in the winding of the muffle, which produced a temperature of approximately 750° C. The silica dish containing the ash was cooled in a desiccator, immediately transferred to a weighing bottle with ground glass stopper, and weighed therefore out of contact with moisture from the air, this precaution being taken in view of the hygroscopicity of the ash observed previously. Without transference from the silica dish, the ash was then treated with an accurately measured volume (15 cc.) of an

$N/10$ solution of sulphuric acid, covered with a glass, heated for one hour on the water-bath, and then transferred quantitatively to a 100 cc. conical flask, the volume adjusted to 50 cc. by the addition of water, and the excess of acid titrated with a $N/10$ solution of sodium hydroxide, using methyl-red (1 cc. of an 0·005% solution in 80% alcohol) as indicator, the end-point being obtained by comparison with a "blank" in a similar flask containing the same amount of indicator in a volume of water equal to that of the dilute acid in the experimental flask.

Preparation of Samples.

As has been mentioned previously, a number of the samples examined were in the form of lint cotton. A representative sample of this was taken and combed carefully by hand, thus eliminating adhering leaf, seed husk, and sand. The remaining samples were in the form of card sliver, slubbing, roving, or yarns, and save in one doubtful case, where the material was obviously contaminated with leaf, were used without further treatment.

Experimental Results.

The data are given in the following tables—

TABLE I.—NORTH AMERICAN COTTONS

	Description	Ash (%)	Ash Alkalinity	Ash Alkalinity per gram of ash
142.	Short-staple Upland	1·08	14·46	13·44
152R2.	Short-staple Upland	1·09	14·80	13·62
75.	Long-staple Upland (Webber 82)	1·25	17·08	13·63
—	Texas	1·11	15·80	14·20
16.	Texas	1·20	16·54	13·76
149.	Texas	1·14	16·47	14·51
212.	Memphis	1·21	18·54	15·27
154.	Salsbury	1·26	18·19	14·46
M.R. 1585.	Wannamaker's Cleveland	1·28	16·74	13·12
M.R. 1586.	Oklahoma Triumph, 44	1·17	16·51	14·14
M.R. 1587.	Mexican Big Boll, strain 6	1·20	15·92	13·24
M.R. 1588.	Mexican Big Boll	1·05	16·51	15·74
	Mean values	1·17	16·46	14·1

TABLE II.—SOUTH AMERICAN COTTONS

	Description	Ash (%)	Ash Alkalinity	Ash Alkalinity per gram of ash
W.C. 41.	Tanguis	1·20	17·28	14·42
M.R. 1119.	Tanguis, rough style	1·26	17·73	14·06
W.C. 53.	Peruvian Smooth	1·35	19·46	14·42
M.R. 1117.	Peruvian Moderate Rough	0·84	10·80	12·81
W.C. 49.	Peruvian Mitafifi	1·06	15·20	14·38
W.C. 61.	Pernam	1·19	18·28	15·33
W.C. 64.	Ceara	1·21	17·80	14·68
	Mean values	1·16	16·67	14·3

TABLE III.—INDIAN AMERICAN COTTONS

	Description	Ash (%)	Ash Alkalinity	Ash Alkalinity per gram of ash
189.	Punjab American, 285F	1·00	15·3	15·3
190.	Punjab American, 289F	1·03	16·2	15·7
192.	Gadag, No. 1	1·27	18·8	14·8
—	Webber-Sind, 49/4	1·47	22·4	15·2
—	Durango-Sind, 236	1·46	22·4	15·4
110.	American, seed Scinde	1·22	18·46	15·15
198.	Cambodia, 211, sliver	1·30	16·7	12·8
	Mean values	1·25	18·6	14·9

TABLE IV.—OTHER OUTSIDE GROWTHS OF AMERICAN COTTON

	Description	Ash (%)	Ash Alkalinity	Ash Alkalinity per gram of ash
185.	Nyassaland Upland, Uganda	1·58	24·83	15·70
184.	Allen, A2, Uganda	1·45	23·23	16·03
186.	Sunflower, S7, Uganda	1·28	19·52	15·31
187.	Webber, W. Uganda	1·51	24·15	15·95
M.R. 1219.	Griffin, S. Rhodesia	1·56	23·57	15·08
M.R. 1209A.	Watts Long-staple, Transvaal	1·38	20·63	14·98
M.R. 1235.	Selected American, N. Nigeria	1·82	27·32	14·97
M.R. 1239.	N. Nigeria (Zaria), 1923 crop	1·64	25·68	15·63
M.R. 1221.	Nyassaland Upland, N. Rhodesia	1·41	22·16	15·69
M.R. 1212.	Zululand Hybrid, Natal	1·44	21·98	15·21
M.R. 1276.	American, Kardofan Province, Sudan	1·81	26·20	14·51
M.R. 1273.	American, Berber Province, Sudan	1·19	18·05	15·24
M.R. 1297.	Webber, Iraq	1·47	22·69	15·44
101.	American, Queensland	1·24	18·76	15·10
M.R. 885.	Durango, Queensland, 1923 crop	1·32	19·08	14·45
	Mean values	1·47	22·5	15·3

TABLE V.—EGYPTIAN COTTONS

	Description	Ash (%)	Ash Alkalinity	Ash Akalinity per gram of ash
157.	Sakel, Government type 30	1·20	18·62	15·54
156.	Sakel	1·23	18·73	15·21
158.	Uppers, Government type 4	1·11	17·28	15·52
73.	Brown, Mitafifi type	1·27	19·01	14·92
155.	Pilion	1·15	17·93	15·64
140.	White Abassi	1·22	18·12	14·86
	Mean values	1·20	18·28	15·28
M.R. 1268.	Gezira Sakel, Sudan, 1924 crop	1·29	21·12	16·41
M.R. 1267.	Sakel, Tokar, Sudan, 1923 crop	1·05	16·64	15·81
151.	Egyptian, Arizona (Pima)	1·45	22·36	15·37
W.C. 49.	Mitafifi, Peru	1·19	18·28	15·33
	Mean values	1·26	20·04	15·86

TABLE VI.—NATIVE INDIAN COTTONS

	Description	Ash (%)	Ash Alkalinity	Ash Alkalinity per gram of ash
W.C. 3.	Oomra	1·07	15·45	14·39
160.	Oomra	1·15	18·64	16·16
W.C. 9.	Bengal	1·10	17·59	15·99
W.C. 1.	Surtee	1·42	20·22	14·03
W.C. 13.	Broach	1·58	21·54	13·61
141.	Broach	1·39	20·00	14·42
194.	Sircar 14	1·30	20·81	16·01
204.	Sircar 25	1·27	19·15	15·05
201.	Surat, 1027 A.L.F.	1·52	22·16	14·54
193.	Karunganni	0·98	16·21	16·51
	Mean values	1·28	19·2	15·1

TABLE VII.—SEA ISLAND COTTONS

	Description	Ash (%)	Ash Alkalinity	Ash Alkalinity per gram of ash
159.	Sea Island	0·92	14·08	15·27
92.	Sea Island	0·83	12·49	15·04
14.	Sea Island	1·10	16·95	15·38
M.R. 1354.	Sea Island, Barbados	1·24	19·14	15·43
M.R. 1357.	Sea Island, St. Vincent	0·70	11·06	15·85
M.R. 1351.	Sea Island, Montserrat	1·10	15·77	14·35
	Mean values	0·98	14·9	15·2
M.R. 1347.	Tortola Sea Island, Virgin Islands	1·10	14·66	13·29
M.R. 1320.	Sea Island, Ceylon	1·19	16·71	14·08
M.R. 1227.	Sea Island, Gold Coast	1·24	14·48	11·63

TABLE VIII.—THE ASH CONTENT OF COMBED SLIVER AND COMBER WASTE

	Description	Ash (%)	Ash Alkalinity	Ash Alkalinity per gram of ash
159.	Sea Island—Card sliver	0·92	14·08	15·27
	1st combed sliver	0·91	13·80	15·11
	1st comber waste	1·19	18·11	15·27
	2nd combed sliver	0·87	13·49	15·45
	2nd comber waste	1·09	16·44	15·03
157.	Sakel—Card sliver	1·24	19·03	15·31
	Combed sliver	1·23	18·65	15·15
	Comber waste	1·39	20·66	14·84

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5—THE SPECIFIC GRAVITY OF WOOL AND ITS RELATION TO SWELLING AND SORPTION IN WATER AND OTHER LIQUIDS*

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SUMMARY

This paper is for the most part purely scientific in character and does not deal directly with any definite manufacturing process or procedure, but rather with a fundamental property of wool fibre. The summary is therefore intended to indicate in a general way, without going into scientific details, the significance of specific gravity determinations in relation to other properties, such as regain and swelling, and its application as a means of investigating the effect on the wool fibre of such reagents as it may meet with in the course of manufacture.

Effect of Sorption on the Actual Determination of Specific Gravity

In the first place, in previous work necessary precautions have been ignored, particularly with regard to the sorptive power of wool, which is much more general than had been supposed. If a liquid is sorbed by wool, the observed density in that liquid will be only an "apparent density" and not the true one. Secondly, many observations recorded are valueless, as the regain of the sample used has not been specified. The wide divergence in values previously given for the density, determined in water, is accounted for by the fact that the "apparent density" in water is now shown to vary with the regain in a definite, and practically identical, manner for all clean merino and crossbred wool free from medulla.

Determinations in liquids, other than water, make it obvious that the sorptive power of wool for water has its counterpart in the case of many organic liquids, but to very different degrees, which explains the varying values obtained by previous observers using different organic liquids. This sorptive effect is a minimum with benzene, toluene, nitrobenzene, olive oil, and oleic acid, in which liquids the results for dry wool are in good agreement. The value in benzene is 1·30 (water=1), which, for reasons stated, is taken as the true specific gravity. The specific gravity at various regains, as may be required for yarn calculations, &c., is given in Table VI., Col. 5, and Graph I. No appreciable variation was found in different samples of medulla-free wool, whether merino or crossbred. Lower values are, however, obtained as the tendency towards kempy nature increases. With other liquids, especially alcohols, only an "apparent density" is obtained, which exceeds the above value by an amount depending on the extent of contraction in total volume, which has taken place as a result of sorption of the liquid by the wool. If such liquids are volatile, for example, alcohol, this corresponds to a definite regain in the vapour, in similar fashion to the regain in water vapour.

Further, the relation between the density, the swelling, and the soaking regain† can be expressed mathematically, and the swelling in water calculated from this equation is substantially the same as that obtained by direct measurement.[1] The accuracy of both methods is thus mutually confirmed.

*Published Privately April, 1923.

† By soaking regain is meant the amount taken up on immersion in the liquid, while ordinary or vapour regain is that taken up from the vapour of the liquid. It is shown in the case of water that they have the same value.

Penetration by Solvents and Oils

From this formula it appears possible, knowing both the "apparent density" and the swelling in any particular liquid, to determine quantitatively the extent of its sorption by wool. A distinction may thus be drawn, which was scarcely possible before, in the extent to which different liquids actually penetrate the fibre. This has an obvious bearing on the behaviour of different materials used in solvent scouring. Thus, for example, alcohol freely penetrates the fibre, and can therefore remove extractable matter from its interior, whereas benzene will tend to remove only surface grease. Also alcohol rapidly brings about the temporary set[2] of yarn, whereas benzene has negligible effect. Again, different wool oils may to some extent owe their varying efficiency, both in spinning and in subsequent scouring out, to the degree in which they actually penetrate the fibre rather than merely grease its surface. Thus definite information on these points should be of practical value.

Influence of Salts on Swelling and Sorption

The swelling accompanying sorption is considerably less than the volume of liquid taken up, and the volume required to be absorbed in order to produce a swelling of 1 cc. can be calculated. This has been termed the compression factor. Common salt reduces the swelling and regain caused by water alone, but also lowers this compression factor, instead of increasing it, as is the case when the regain is lowered by ordinary dehydration (with dry air or glycerine). In other words, the fibre swells more when it absorbs water from salt solution than when it absorbs the *same amount* of water from moist air. This suggests that the resilience of the fibre undergoes a different modification in salt solution from that produced by ordinary dehydration. Such facts as these may assist in interpreting the function of common salt and other substances in retarding or assisting dyeing and milling.

Density Methods of Determining Regain and of Estimating Wool-cotton Mixtures

It is shown how in the case of grease-free, undyed material, the above may be ascertained by a simple density measurement. Since grease and dye may affect the regain of cloth in irregular manner, these methods are at present put forward only as interesting developments of specific gravity determinations, but it is hoped that by suitable modification they will be applicable to commercial samples.

INTRODUCTION

The actual space taken up by a given weight of wool under various circumstances is a value which is basic to quantitative measurements of many kinds. It is required in calculations on the diameter of fibres and yarns, and on design. It is also an essential factor in the quantitative relationship of fibre diameter to count and quality, and in the accurate determination of the amounts of reagents taken up by wool. Further, a complete knowledge of the volume changes of fibre and yarn with regain, depends upon accurate values for the specific gravity of dry wool and its variation with regain. In all the foregoing, the extent of variation in specific gravity of different types of wool is of importance. Again, it will appear in the sequel that specific gravity determinations are of considerable significance in connection with the degree of penetration of solvents used for wool scouring, particularly the marked difference between alcohol and benzene, and in assisting to interpret the swelling or shrinking of wool fibre under various treatments affecting spinning, dyeing, and milling properties. Also it will appear that specific gravity measurement under suitable conditions provides a simple method of determining regain, and of estimating the proportion of cotton in wool-cotton mixtures. It is therefore remarkable that no systematic attempt has so far been made to look into the wide discrepancy of values given in the literature, and to ascertain the true value under standard conditions, and the change in value with altered conditions, of this important physical characteristic.

PREVIOUS WORK

Reference to the literature reveals specific gravity values differing much too widely to permit of the adoption of a satisfactory figure, as will be seen from the following list—

Wool Used	Condition	Medium	S.G./Water	Observer
Merino	Air-dried ...	Water ...	1·295 ...	Stockhardt, see reference to Königsborn below.
Southdown Merino	,, ...	,, ...	1·271 ...	
Southdown Franconian	,, ...	,, ...	1·257 ...	
Coarse French Merino	,, ...	Olive Oil	1·3145 ...	Königsborn, "Das Wollhaar des Schafs," p. 146.
,, ,,	,, ...	Water ...	1·314 ...	
Upper Silesian Cloth Wool	,, ...	Olive Oil	1·3176 ...	
,, ,,	,, ...	Water ...	1·318 ...	
Oxford Down Ram	,, ...	Olive Oil	1·3198 ...	
46's Crossbred ...	Dehydrated	Water ...	1·2899 ...	Wilkinson & Booth, Leeds Text. Journ., 1915, p. 73
,, ...	,,	Alcohol ...	1·2810 ...	
64's Botany ...	,,	Water ...	1·288 ...	
,, ...	,,	Alcohol ...	1·2898 ...	
Combed Wool ...	"Normal"	Benzene	1·30 ...	Vignon, J. Soc. Dyers and Col., 1893, p. 204.
Woollen Yarn ...	,, ...	,, ...	1·30 ...	
Combed Mohair ...	,, ...	,, ...	1·30 ...	
Not stated ...	—	—	1·26 ...	Ure, Philosophy of Manufactures, p. 98.
Various	—	—	1·28—1·33	Heermann, J. Soc. Dyers and Col., 1912, p. 273.

Königsborn remarks that the differing values in water previously given for different wools is probably due to the fact that they swell to different degrees in water; and also that during absorption of water by hygroscopic bodies, a compression occurs, and thus from a determination in water a higher specific gravity than the actual value will be obtained. This latter statement is correct, but with regard to the former, the present work, and the measurements on the swelling of wool fibre in water both lead to the conclusion that the average swelling is substantially the same for all qualities of medulla-free wool, though individual fibres may vary. Königsborn concludes that the specific gravity of medulla-free wool "in the open air" is 1·318 to 1·320, finer qualities being apparently slightly less dense than coarser qualities.

The initial work on this subject was for the purpose of ascertaining the volume of a given weight of wool used for sorption experiments, this information being necessary for obtaining exact values of sorption from reagents.[3] As the work progressed, however, various unsuspected factors revealed themselves, which were of obvious practical significance in several other directions, and which made it desirable to extend the investigation to find out in what degree density measurements could be made use of in the study of these problems.

GENERAL REMARKS ON THEORY

The specific gravity bottle method was used in most of the previously published work. It will be clear that by this method the weight (and hence the volume) of liquid displaced from the bottle by a known weight of the substance, only gives the true volume of the substance if there is no alteration in total volume when the substance and liquid are brought together. This is satisfied if (*a*) the substance is entirely unaffected by the liquid, or (*b*) the volume by which the substance swells (or shrinks) is exactly equal to the volume of liquid absorbed by (or expelled from) the substance when immersed. Regarding (*b*), the swelling of ordinary wool fibre in water and

various aqueous solutions, and its shrinkage in glycerine, are well known. It is also known that with most hygroscopic materials a contraction in total volume occurs during absorption of water, and this is probably true for sorption in general.

"Apparent" Density

Where this occurs, an "apparent density" greater in value than the true density will be obtained. It is therefore unlikely that condition (*b*) will be satisfied in any medium which is sorbed by wool, and this method can only be relied upon to give the true specific gravity with media for which wool has no sorptive tendency. Investigation shows that many organic liquids are unsuitable,* and that the well-known sorptive power of wool for water has its counterpart to various degrees in a number of organic media. The practical significance of this will be dealt with later. Its significance regarding the conflicting values given for the density of wool is obvious.

METHOD

The wool used had been thoroughly extracted in a soxhlet with pure alcohol. The specific gravity bottle containing the sample was dried at 102° C. under reduced pressure in an electrically-heated air bath placed in a vacuum desiccator, until constant in weight. The bottle was then attached to a tube leading below the liquid to be used, contained in a pressure flask connected with the pump. Except in the case of water, drying tubes were interposed to prevent access of moisture from the pump, and the liquids employed were thoroughly dried by suitable means before use. The apparatus was exhausted, the pump cut off, and the vacuum slowly released through the drying tubes, by which means the liquid passed over into the specific gravity bottle. This was repeated as often as was necessary to secure complete removal of air. The bottle and its contents were brought to constant temperature in a thermostat-controlled water-bath at 25° C. in every case.

APPARENT DENSITIES IN WATER

It will be evident that with water the true specific gravity will be given in the case of completely saturated wool, and for this only, since it is only in this case that the total volume of wool+water is unchanged on immersion of the wool. For all cases of incomplete saturation a contraction in volume takes place which results in a correspondingly higher "apparent" density.

Thus if W = weight of dry wool.

w = weight of moisture originally in wool.

w_1 = weight of water filling bottle.

w_2 = weight of wool plus water filling bottle.

Apparent sp. gr. of wool $\Delta_A = \dfrac{W+w}{W+w+w_1-w_2}$

For a given dry weight of wool w_2 must necessarily be the same whatever the actual regain of the wool at the time of its introduction into the bottle. Therefore, w_1-w_2 is also the same for W grams of dry wool whatever its regain may have been at the time of weighing, and $(W+w_1-w_2)$ may be written W_1. Thus the above expression may be written—

$$\frac{W+w}{W_1+w}$$

Obviously the apparent density is a maximum $\dfrac{(W)}{(W_1)}$ when $w=0$, and from this apparent density can at once be calculated for any regain by adding

* It may be remarked that mercury is unsuitable, as its surface tension prevents complete contact with the irregular boundaries of the fibre.

the weight of water corresponding to that regain, to both numerator and denominator.

Apparent Density of Dry Wool in Water

To obtain the dry weight, the sample was placed in a tube with ground-in stopper and taps at inlet and outlet. This was placed in a tube furnace, electrically-heated and controlled to give 105° C. inside the jacket and 102–3° C. inside the tube itself. A slow current of air, finally dried over phosphorus pentoxide, was drawn through the heated tube. The following results were obtained—

Table I.

Wool used	Weight of Dry Wool	Weight of Water displaced	Apparent density
Sydney 60's	1·5466	1·1077	1·3964
,,	2·0310	1·4534	1·3970
Sydney 80's	2·2616	1·6198	1·3962
Aust. 50's	3·4225	2·4545	1·3943
English Skin 56's	1·5565	1·1147	1·3963
Santa Cruz 56's	1·6907	1·2105	1·3966
English 32—36's	2·8970	2·0727	1·3976
Blackface	2·1647	1·5539	1·3962

All the above values are within the small range of 0·24%, and for purposes of calculation the value 1·3965 has been adopted. Thus, 1·3965 grams of dry wool give an increase over the weight of bottle plus water, of 0·3965 grams, or an increase of 1 gram on immersion corresponds to 3·522 grams of dry wool.

Apparent Density of Moist Wool

The following results from a series of wools (all alcohol extracted) brought to the same regain (in the humidity room), show that the agreement in dry weight apparent densities extends to moist weight apparent densities also.

Table II.

Wool used	Apparent density, Humidity about 69
Sydney 80's	1·3215
,, 60's	1·3201
Australian 50's	1·3198
English 32—36	1·3210
Blackface Kempy	1·3177

Only with Blackface is there a serious difference.

Variation of Apparent Density with Regain

It will be observed that the expression $\frac{1{\cdot}3965+w}{1+w}$ gives the apparent density when w grams of water are attached to 1·3965 grams of dry wool. This may be re-written— $\frac{100+R}{71{\cdot}6076+R}$, where R=percentage regain.

The curve shown in Graph No. I., constructed from values calculated from the expression $\frac{100+R}{71{\cdot}6076+R}$, thus gives the regain corresponding to any observed apparent density for clean wool with reasonable accuracy for all but the coarsest kempy kind.

Saturation Regain and "Soaking" Regain

The regain of saturated wool at 25° C. was found by placing a sample of known dry weight on a grid standing over water in a large stoppered jar, the whole being immersed during a week-end in the thermostat at 25° C. The stopper was removed and the wool quickly pushed into a weighing bottle also inside the jar, with a glass rod. The mean value obtained was

33%. For this temperature Hartshorne gives 31·8%, and Schloesing 34-35%. Thus, at 33% regain, the calculated apparent density is—

$$\frac{100+33}{71\cdot6076+33} = 1\cdot270$$

Now assuming that the saturated wool undergoes no further change on soaking in liquid water, this calculated apparent density is also the true density of saturated wool. As will be seen in Table VI., the values 1·267 and 1·265 were obtained for saturated wool in benzene and olive oil respectively. These are in good agreement with the above. That they are slightly lower is probably due to slight unavoidable loss of water from the wool during the evacuation of the bottle to remove the air. These closely agreeing values for *saturated* wool, in water (calculated) and benzene (observed) respectively, show that either—

(1) The amount of water absorbed from saturated air is the same as from liquid water; or

(2) If there is further absorption of water by the saturated wool (and consequently further swelling) on soaking it in liquid water, this must take place without change in *total* volume, and would not be detected by density measurements.

The calculated swelling in water (see p. T63), assuming the same regain as in saturated air, is, however, in good agreement with the observed swelling in water. The "soaking" and "saturation" regains for water thus appear to be substantially the same.*

OBSERVED DENSITIES IN VARIOUS LIQUIDS

For this series Australian 60's top, alcohol extracted, was used. The following values, including that for dry wool in water, were obtained—

Table III.

Medium	Weight of Dry Wool in grams	Weight of Liquid displaced	Sp. Gr. of Liquid / Water at 25° C.	Apparent S.G. of Wool / Water at 25° C.
Methyl Alcohol ...	1·7106	0·9617	0·79149	1·408
,, ...	2·1561	1·2106	0·79164	1·409
Water	1·5466	1·1077	1·0000	1·3964
Ethyl Alcohol ...	1·3609	0·7812	0·79684	1·3880
,, ...	2·0090	1·1536	0·7969	1·3877
(Glycerine) ...	1·7054	1·6119	1·2617	(1·334)
Light Naphtha ...	2·0676	1·1157	0·71773	1·330
,, ...	2·3389	1·2787	0·72503	1·323
Paraffin B.P. ...	1·8546	1·2433	0·88746	1·324
,, ...	2·1191	1·4630	0·88789	1·316
Amyl Alcohol ...	2·0064	1·2312	0·8089	1·318
,, ...	1·0572	0·6480	0·80967	1·317
Carbon Tetra-chloride ...	1·7838	2·1669	1·590	1·309
Oleic Acid ...	2·2793	1·5523	0·89146	1·3092
,, ...	2·1369	1·4591	0·89164	1·306
Nitro Benzene ...	1·7711	1·6259	1·2046	1·309
,, ...	2·0643	1·9039	1·202	1·3034
Olive Oil	1·2747	0·8951	0·9170	1·306
Toluene	1·9416	1·2805	0·8615	1·306
Benzene	1·5936	1·0695	0·8754	1·304
,, ...	1·7882	1·1996	0·8751	1·3043

* Work on the swelling of wool fibre in moist air subsequent to that already published[4], shows that the swelling when suspended in air above water is not quite equal to that in the liquid itself, but corresponds to 97% saturation on the curve. At present it cannot be said definitely if this very slight difference is real, or due to the air not being completely saturated with water vapour by the method employed.

The inert solvents benzene, toluene, and nitrobenzene give the lowest, and practically identical, results. The high value with water is due, as already explained, to the contraction taking place on sorption of water. The conclusion must be made that wherever a high value is shown, provided the medium is chemically inert towards wool, sorption of the medium with accompanying contraction, has occurred. It is significant that the highest values are obtained with methyl and ethyl alcohol, which have a chemical constitution similar to that of water. With amyl alcohol the apparent density, though lower than with methyl and ethyl alcohols, is still above the normal value, indicating that some sorption has taken place. Glycerine, being alcoholic in constitution, might by analogy be expected to show a slight sorption, though it is generally accepted that it completely shrinks the fibre to the same diameter as in dry air. The density values above suggest that some sorption occurs with glycerine, which would presumably require an accompanying swelling of the dry fibre, but in this case experimental difficulties, particularly of eliminating air, and of ensuring perfectly dry glycerine, may easily vitiate the result. Water will naturally be abstracted from moist solvents by dry wool, and a high value will be obtained. Thus ordinary undried olive oil gave 1·33, compared with 1·306 with dried olive oil.

Regain with Volatile Organic Liquids

The high values with methyl and ethyl alcohols made it of interest to examine whether dry wool showed a "regain" towards the vapour of these liquids in similar manner to its regain towards water vapour. Approximate regains at 25° C. were found to be as follows—

Table IV.

Liquid	Regain
Water	33%
Methyl Alcohol	26·3%
Ethyl Alcohol	21·3%
Benzene	under 0·5%

The dehydrating action of ethyl alcohol is well known, as is its power to extract water from moist wool, but that alcohol *replaces the water* so extracted appears to have escaped notice. On the contrary, the inability of alcohol to penetrate the fibre has been taken for granted from analogy with the presumed non-permeability of alcohol towards gelatine. This presumption has been used to explain the resistance of certain dyestuffs to extraction by alcohol,[5,6] but it is now evident that alcohol freely penetrates the wool substance. With methyl alcohol the regain is still higher, about 26%, as compared with 33% for water, and in each case the wool, though absorbing a large percentage of liquid, showed no sign of free liquid. As in the case of water, raising the temperature lowers the saturation regain, and on warming the tube, liquid alcohol appears in droplets on the wool, gradually disappearing again as the tube regains ordinary temperature. The rate of regain with alcohol appeared to be slower than with water, but this point was not further investigated. The reality of this regain is apparent on comparing the behaviour with benzene. With this there is no appreciable regain, though since the vapour pressure of benzene is considerably greater than that of ethyl alcohol at ordinary temperatures, there was greater opportunity of contact.

Behaviour of Aqueous Alcohol

That both water and alcohol are sorbed from a mixture by dry wool is proved conclusively by the following experiment—

Density of original mixture ... 0·9139/water at 25° C. (0·91126/4°).
Density after experiment ... 0·9135/water at 25° C. (0·91084/4°).
Apparent density of dry wool 1·390.

This value is intermediate between 1·3965 for pure water and 1·388 for pure alcohol. Thus the values for dry wool in water and alcohol given by Wilkinson and Booth (p. T55) are not reconcilable with the present writer's observations. The strength of the alcoholic solution increased slightly from 49·36% to 49·55%, showing that for approximately equal quantities of alcohol and water, the latter is sorbed in greater proportion. This is to be expected from the fact observed above that the regain for water is higher than that for alcohol.

Regain in Non-volatile or Slightly Volatile Liquids

In these cases, the saturation regains at ordinary temperature in the vapour can only be reached after very great lapse of time, making their determination practically impossible. The apparent density alone estimates only the contraction in volume, and yields no information as to the actual quantity of liquid sorbed, though it does give some idea of the relative sorption from different liquids. From a knowledge of both the apparent density and the swelling, however, the actual quantity sorbed can be calculated, as illustrated on p. T63. Information of practical importance is thus obtainable, on the one hand, regarding the relative penetration of wool fibre by different wool oils, and materials used for solvent scouring, and on the other, the part played by various salts in aqueous solution.

Regain and Power of Setting Yarn

In addition to the contrast in density and regain values for alcohol and benzene quoted above, another striking difference is shown in their effect on the properties of yarn. A warp yarn of Port Philip 80's spun to 2/32's, soaked in benzene, stretched, and allowed to dry, acquired no temporary set, but recovered almost entirely on release, just like the ordinary air-dry yarn. When soaked in alcohol, however, it behaves in a similar manner to yarn soaked in water.[2] It will stand a 25% *elongation* and, if dried before release, it still retains about 15% increase in length. If then soaked in alcohol again and dried slack, it *shrinks to* 12% *less than its original length.* It now exhibits the marked increase in elasticity shown by yarn from which the temporary set has been removed. It appears twice as bulky and altogether softer than the untreated yarn. These preliminary observations are included here as supporting the inference drawn from the specific gravity and regain experiments. A fuller investigation of this behaviour of alcohol, and the behaviour of other solvents, appears desirable.

TRUE DENSITY OF WOOL

The concordant density results obtained with benzene (and also with toluene and nitrobenzene) support the inference from the above regain and setting experiments, *i.e.* that wool has no sorptive capacity for these solvents. The consequent conclusion that the true density of dry wool is obtained in these media is further supported by the agreement between the amount of swelling in water calculated from this value and that given by direct

measurement (see p. T63), and by the absence of swelling when dry wool fibre is placed in dry benzene.*

The value at 25° C. is 1·304/water at 25° C. or 1·300/water at 4° C. for the sample of wool used.

Of the various values quoted in the literature (see p. T55) only those of Vignon, carried out on conditioned wool in benzene appear to be reliable. The effect of condition on the density is shown in Table VI.

Variation with Different Types of Wool

The impression is gained from literature statements that the density of wool varies appreciably with different qualities. For clean wool in its dry state the following values (obtained in dry benzene as previously described) indicate that it is substantially the same for all qualities which are medulla-free, and diminishes as the kempy character increases, no doubt owing to the incomplete removal of the air present in the medulla.

Table V.

Wool used	Δ/Water at 25° C.
Australian 80's	1·303
Sydney 60's	1·304
Colonial 50's	1·302
,, 46's	1·30
Lincolns 32—36's	1·294
Blackface	1·180

Variation with Regain

For these determinations benzene was used. To avoid error due to gain or loss of water from the wool to the benzene, the latter was brought to the same humidity, in the case of low humidities, by standing it in contact with a quantity of the partially dried wool before using, and for the higher humidities, by agitating with air at the corresponding humidity. Only a very slight variation in the specific gravity of the benzene was observed. The wool is very rapidly "wetted out" by the benzene, and the specific gravity bottle was filled in the ordinary way, only a brief evacuation being subsequently applied for complete removal of air, to minimise loss of moisture from the sample. The results obtained are given in the fifth column below. The corresponding apparent densities in water (last column) are included for comparison. The wool used was Sydney 60's.

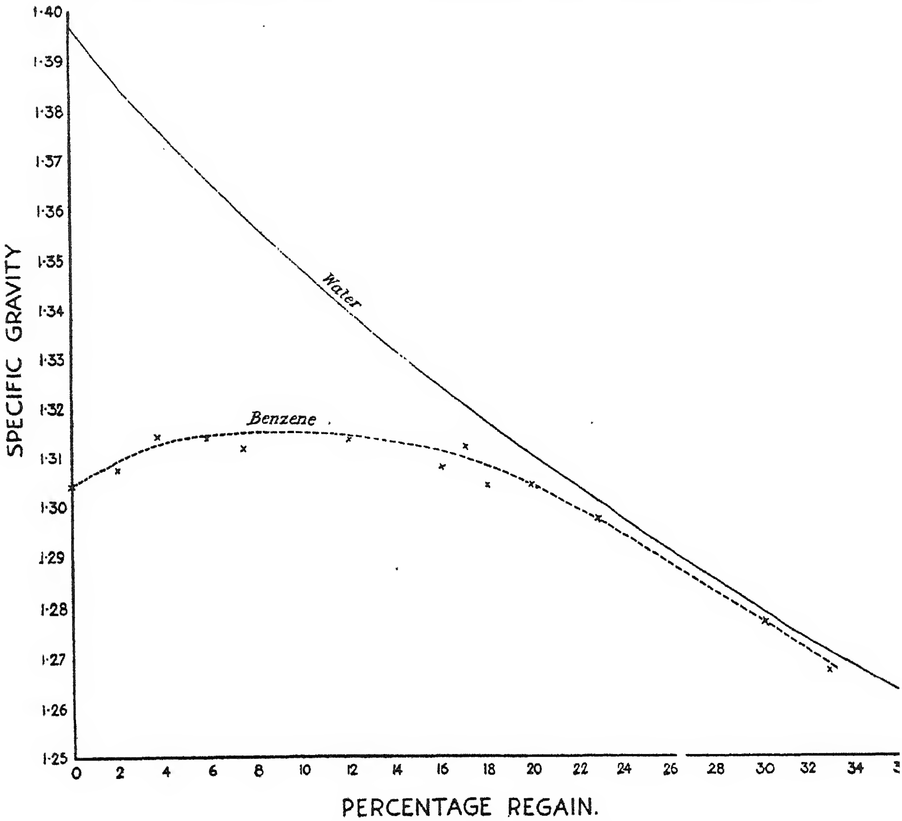
Table VI.

Regain %	Actual Wt. of Sample	Wt. of Benzene displaced	Sp. Gr. of Benzene / Water at 25° C.	S.G. of Wool / Water at 25° C.	Apparent Densities in Water at 25° C.
Zero	1·5936	1·0695	0·8752	1·304	1·3965
2·0	2·5838	1·7312	0·8752	1·307	1·386
3·75	1·6047	1·0704	0·8754	1·314	1·377
5·9	1·6383	1·0965	0·8753	1·314	1·366
7·5	1·6625	1·1093	0·8754	1·312	1·359
12·0	2·1425	1·4276	0·8748	1·313	1·339
17·0	4·4977	3·0001	0·8754	1·312	1·3205
17·3	1·3532	0·9436	0·9123 (olive oil)	1·308	1·3193
20·0	2·5256	1·6949	0·8755	1·304	1·310
22·85	2·0682	1·3954	0·8756	1·297	1·300
30·2	2·2864	1·5666	0·8756	1·277	1·278
33·0	1·7231	1·1909	0·8755	1·267	1·271
33·0	1·6868	1·2163	0·9123 (olive oil)	1·265	1·271

* These observations have been recorded in detail in a later contribution to "Swelling of Wool Fibre."[7]

(To determine the specific gravity of the benzene in each case, sufficient was transferred from the bottle containing the wool, to fill a smaller specific gravity bottle of 25 cc. capacity.)

The values are somewhat fluctuating, but the smoothed curve drawn from them in Graph No. I. indicates a tendency for the density to rise slightly in the initial stages of absorption of water to a fairly constant value over a considerable range of regain, and to fall again with increasing rapidity with ascending regain, down to a saturation value of approximately 1·27.



GRAPH NO. I.

Variation of Apparent (Water) and True (Benzene) Densities of Wool with Regain.

The average value for 18–20% regain is 1·305, which, reduced to water at 4° C., is 1·30, identical with Vignon's value for wool at normal regain, obtained by the same method.

THE RELATION BETWEEN APPARENT DENSITY, SWELLING, AND SORPTION IN PURE MEDIA

Let V_t = true specific volume of dry sorbent.

V_a = apparent specific volume of sorbent in medium used.

V_m = specific volume of medium.

S = unit volume increase on swelling.

x = sorption per gram of sorbent.

Then $V_t - V_a$ = contraction in volume per gram,

and $S \times V_t$ = volume increase per gram of sorbent.

Hence, volume absorbed $= V_t - V_a + SV_t = xV_m$.

Calculated and Observed Swelling in Water

Applying this formula to the results obtained for wool in water—

$$V_t = \frac{1}{1 \cdot 30} = 0 \cdot 7692 \text{ (Water} = 1)$$

$$V_a = \frac{1}{1 \cdot 3927} = 0 \cdot 7182 \text{ (Water} = 1)$$

If we take $x = 0 \cdot 33$ (regain $= 33\%$).

Then $S \times V_t = 0 \cdot 33 - (0 \cdot 7692 - 0 \cdot 7182), = 0 \cdot 33 - 0 \cdot 0510.$

$= 0 \cdot 2790.$

and $S = 0 \cdot 363.$

Thus the swelling in water is 36·3% by volume. This value is almost identical with the average of 36% obtained by direct measurement of individual fibres[1], and the accuracy of both methods is mutually confirmed.

Calculated Swelling in Alcohol

Similarly for ethyl alcohol we have—

Regain = 21·3%.

Apparent density = 1·388.

Density of alc. = 0·7969.

Then since $V_t - V_a + SV_t = xV_m$

$$S = \frac{xV_m - (V_t - V_a)}{V_t} = \frac{0 \cdot 2673 - 0 \cdot 048}{0 \cdot 7692} = 0 \cdot 285$$

Calculated swelling is therefore 28·5% by volume.

APPARENT COMPRESSION OF THE SORBED MEDIUM

The medium entering the wool apparently occupies a smaller volume than its normal value. This could be accounted for without assuming any real compression by a filling up of cavities within the fibre without increase in its external dimensions, but the necessary cavity volume (7% of the fibre volume calculated from the values for water) would seem large enough for such cavities to be microscopically observable. It is alternatively accounted for by assuming a real compression, caused by swelling of the contiguous structural units of the fibre against each other. This would result in a net increase in density, shared between the wool substance and the sorbed water, or other medium in some proportion which is not known, but which for comparative purposes may be assumed to be taken up entirely by the sorbed medium.

Compression Factor

The volume of medium which on being sorbed causes a swelling of 1 cc. may for convenience be termed the factor of apparent compression of the medium, or, briefly, the compression factor. The value of this factor is $\frac{xV_m}{SV_t}$. This for water=1·18 at saturation, and for ethyl alcohol 1·22.

Calculated Swelling in Moist Air

The following table shows the compression factor of the sorbed water, and the corresponding swellings, calculated from the specific gravity curve, Graph No. I., at various regains.

Table VII.

Density of Wool	Regain R	Approx. Humidity (Harts-horne)	Specific Volume × 100	Vol. of 100+R grs.	Compression Factor = Regain / Vol. incr.	% Swelling by Vol.
1·3040	0	0	76·92	—	—	—
1·3095	2	2	76·37	77·90	2·04	1·28
1·3135	5	11	76·14	79·95	1·65	3·94
1·3150	7	20·5	76·05	81·37	1·57	5·8
1·3150	10	36	76·05	83·65	1·48	8·8
1·3125	15	61	76·19	87·62	1·40	13·9
1·3040	20	81	76·92	92·30	1·30	19·7
1·2915	25	94	77·43	96·79	1·26	25·8
1·2765	30	99	78·34	101·85	1·20	32·5
1·2680	33	(101)	78·88	104·88	1·18	36·4

The calculated swellings are in fair agreement with the values from direct observation[4] at the higher regains, but somewhat greater at the lower regains. At the very low regains the possible error is large, but the increasing compression with diminished regain is unmistakable. The initial sorption of water by wool is accompanied by an apparent contraction much greater than that between alcohol and water, and comparable with that between sulphuric acid and water.* This could be explained by a mere filling up of pores, but the appreciable heat evolved rather suggests that it is of intimate character akin to chemical combination, which is no doubt connected with the difficult removal of the last traces of water from wool.

EFFECT OF SALT SOLUTION ON SOAKING REGAIN

Experiments in progress on the sorption of neutral salts indicate that sodium chloride is sorbed, if at all, in such small amount as to have negligible effect on the density of wool.

Apparent Densities of Dry Wool in Salt Solutions

These are given below, and the curve plotted from these values is shown in Graph No. II.

Table VIII.

Grams NaCl per 100 grs. solution	Spec. Gr. of Salt Solutions	Apparent Density of Wool
1	1·007	1·3842
2	1·0138	1·380
4·3	1·0294	1·3775
9·7	1·0694	1·360
9·7	1·07	1·366
14·2	1·1038	1·355
16·3	1·1191	1·3532
16·4	1·120	1·3520
21·8	1·1637	1·345
25·6	1·1956	1·3475

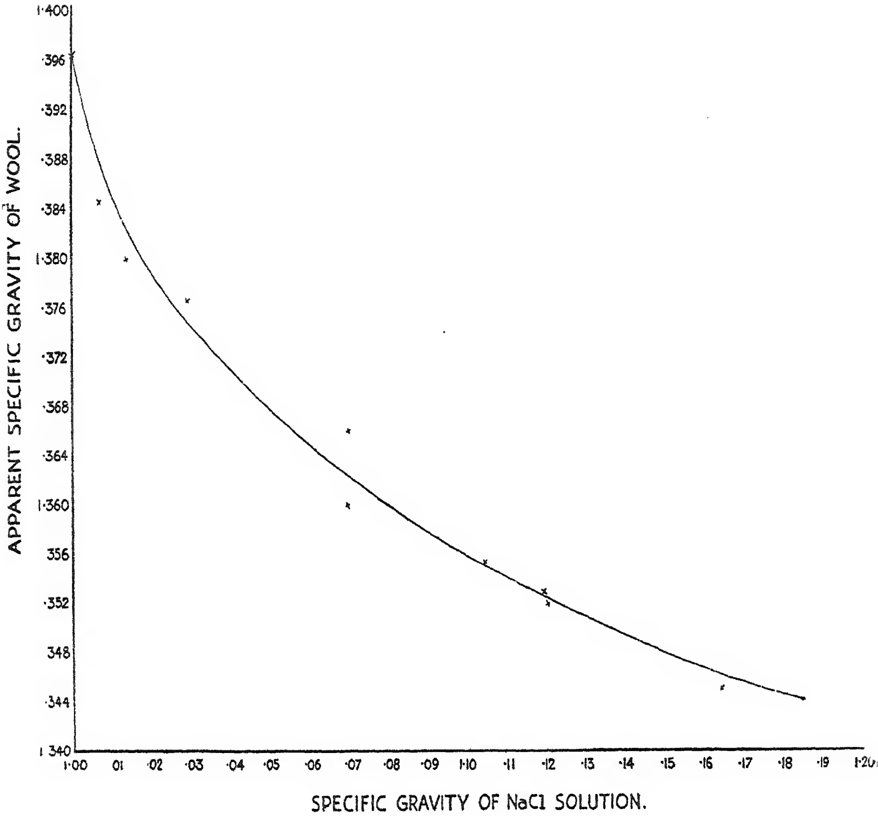
Assuming the sorption of sodium chloride to be negligibly small, the compression factor of the sorbed water, and the regain, can be calculated from the apparent density of the wool and the corresponding swelling,[8] as previously shown.

Taking, for example, a 20% solution (Δ1·12) in which the observed swelling is 31·6% compared with 38·4% in water, or 30% against the average 36·3%, and the apparent specific volume of the wool is 0·7394, we have—

$$SV_t = 0{\cdot}30 \times 0{\cdot}7692 = 0{\cdot}2308.$$

*This question is under investigation in the Physics Department of the Research Association.

Hence the regain $= 100 \times (0{\cdot}7692 - 0{\cdot}7394 + 0{\cdot}2308) = 25\%$, and the compression factor $= 1{\cdot}08$, whereas for an ordinary 25% regain the compression factor is $1{\cdot}26$.



GRAPH No. II.

Apparent Specific Gravity of Dry Wool in Common Salt Solutions.

The shrinking and dehydration produced in salt solution are thus accompanied by a *diminished* compression factor instead of the increased compression accompanying ordinary dehydration. In other words, the fibre swells more when it absorbs water from a salt solution than when it absorbs the *same amount* of water from moist air. The apparent density of wool in salt solutions may thus provide a new point of view regarding the theory of the shrinking effect of salt on swollen wool, and of its retarding effect in dyeing and milling. The extent of compression is obviously connected with the resilience of the fibre, and it is very suggestive that with caustic soda, milling power first increases and then decreases as the strength of caustic is increased. This could be explained on the hypothesis that when caustic soda solution is used to increase the swelling of the fibre as compared with water, the first additions of caustic cause further water to enter the fibre without marked decrease of compression, but as more caustic is added, a point is reached where the structure of the fibre weakens and water enters, as it does with gelatine, under a comparatively small compression, when the milling capacity again diminishes.

Mr. R. J. Smith (Chemical Assistant) has ably assisted in carrying out the experimental work.

APPENDIX

Estimations by Means of Specific Gravity Values

The following methods, while possibly of practical value, especially in cases where it may be desirable to preserve the actual samples intact, are put forward here only as interesting developments of specific gravity determinations, since the numerical factors are derived only from small scale experiments, and from undyed and perfectly clean wool and cotton. Grease and dye may affect the regain of cloth in irregular manner, also work now in progress shows that the regain of wool may in some cases be affected by finishing processes, but the possibility of adapting these methods to large scale tests of commercial samples is under consideration.

Determination of Regain of Wool

As shown on p. T57 the equation—

$$\Delta_A = \frac{100+R}{71{\cdot}6076+R}$$

gives the regain (R), corresponding to any observed apparent density in water (Δ_A). The regain of a sample can therefore be obtained with reasonable accuracy for all but the coarsest kempy kinds; either from the above equation or from the curve constructed from it, shown in Graph No. I. This method, which depends on estimating the further amount of water the sample can take up, instead of the amount which can be expelled from it, forms a useful check on the latter method, for determining the relative amount of dry wool in samples used for research purposes.

Estimation of Dry Wool Content

It may also be noted that the dry wool content of a scoured sample is approximately given by multiplying the increase in weight of a specific gravity bottle containing water and the sample, over that of the bottle with water only, by the factor 3·522, as shown on p. T57.

Example—

Weight of bottle full of water ... ... 70·2600 grs.
Weight of bottle with wool in, filled with water 70·8203
Increase ... ... 0·5603
Therefore weight of dry wool $= 0{\cdot}5603 \times 3{\cdot}522$
weight of sample of greasy taken $= 3{\cdot}65$ grs.

$$\% \text{ dry wool} = \frac{0{\cdot}5603 \times 3{\cdot}522 \times 100}{3{\cdot}65} = 54\%$$

Regain of Cotton

Further, the specific gravity method of estimating regain is applicable to any colloid showing a definite saturation regain.

For instance, pure cotton shows an apparent dry density of 1·61.* The regain of a sample can therefore be found either from the equation—

$$\Delta_A = \frac{100+R}{62{\cdot}1+R}$$ or from a curve constructed from it.

* The value found for cotton wool is 1·609, and for a sample of unsized, scoured and alcohol-extracted calico, 1·611. The possible variation with cotton of various origins has not been investigated.

Example—

A sample of cotton cloth, after keeping in the humidity room at 64·5 humidity and 75° F., gave an apparent density of 1·547.

Its regain is therefore given by—

$$1{\cdot}547 = \frac{100+R}{62{\cdot}1+R}$$

Whence $R = 7{\cdot}2\%$

The dry weight (at 102–5° C.) of a similar sample gave R=7·5%.

For cotton at 65% humidity, and 75° F., Schloesing gives R=7·3% and Hartshorne 8·6%. Hartshorne's values in this region appear too high.

Estimation of Wool-cotton Mixtures

Again, the approximate per cent. of cotton in wool-cotton mixtures is obtained from the apparent density of the dried sample.

Thus, if x = % of cotton in mixture—

$$\frac{x}{100-x} = \frac{\Delta A - 1{\cdot}396}{1{\cdot}61 - \Delta A}$$

where A is the observed apparent density.

Example—

A piece of velour cloth (alcohol extracted) gave an apparent density of 1·419, therefore the proportion of cotton = 11%.

Analysis by caustic soda gave 12·4%.

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6—A COMPARISON OF MEASUREMENTS OF DIAMETERS OF WOOL FIBRES WITH THE MICRO-BALANCE AND THE PROJECTING MICROSCOPE, WITH APPLICATIONS TO THE DETERMINATION OF DENSITY AND MEDULLA (KEMP) COMPOSITION

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SUMMARY

The results obtained by the two methods described in this paper are in remarkably good agreement for non-medullated wools, and the gravimetric (weighing) method is shown to be a convenient means of ascertaining fibre diameter. It also affords evidence of the reliability of the regain and specific gravity values given in previous publications (Nos. 38 and 19), namely, 1·30 for the specific gravity of grease-free dry wool.

With medullated or kempy fibre the calculated diameter is less than the observed diameter, the difference increasing with the proportion of medulla present. This discrepancy is of significance in several directions. For example, the proportion of air space in the medulla itself and in medullated fibres as a whole can be approximately ascertained. It appears that the medulla itself contains about 90% air space. Also, in deriving relations between diameter of fibre and count of yarn in the case of coarse, kempy wools, allowance must be made for the fact that a kempy fibre is light in weight, as compared with its diameter. In calculating the average area of cross section, the method was adopted of calculating the area of cross section from each reading of diameters separately and then averaging the values of the cross section. This was found to give more accurate results than a calculation derived from the average diameter.

INTRODUCTION

A systematic investigation of fibre diameter, using the projection apparatus described in the Interim Report of September 1917 (p. 17), has been in hand for some time past. Although much valuable statistical information has been accumulated, it is still insufficient to meet the objects in view, as set forth in that report, and its publication is therefore reserved for the time being.

In the meantime an alternative method has been investigated, which consists essentially in weighing, by means of a micro-balance, a measured length of fibre at known humidity. The comparative results given by this gravimetric method and by direct observation of the magnified fibre are described below.

EXPERIMENTAL WORK

The Micro-balance

The form of micro-balance is similar to that in use elsewhere* and consists essentially of a filament of phosphor bronze, 0·002 cms. in diameter and 14·54 cms. long. The filament is soldered at one end to a torsion head, and at the other to a screw working in a horizontal direction by which tension can be applied without torsion. The two ends are attached to rigid brass

* *E.g.* by Dr. W. L. Balls, F.R.S., Fine Cotton Spinners' and Doublers' Association, Research Department.

pillars 1·27 cms. in diameter, mounted vertically on a rigid board. The balance beam consists of a glass rod approximately 0·006 cms. thick, at one end of which a fine sharp-angled hook is bent by fusion. The other end is drawn out to a fine point. The whole beam is constructed by drawing out solid glass rod to the required thickness. The beam is carefully balanced at the middle of the wire at right angles to it, so as to swing horizontally when in the zero position. It is then fixed in position by a drop of molten shellac and left to harden. The beam for these experiments was approximately 20 cms. in length and the indicator end swung over an arc of radius 10 cms. The circular scale was prepared photographically from an accurately divided celluloid protractor. This was mounted on a vertical brass disc immediately behind the beam, and so arranged that it was capable of adjustment in three directions at right angles. The filament was brought centrally through a hole at the middle of the scale and the beam swung in front of it parallel to the plane of the disc. The whole apparatus was enclosed in an air-tight glass case and carefully calibrated. The wire was initially free from torsion. The deflections of the indicator across the scale were read through a telescope placed two metres away from the instrument (and focussed so as to give an enlarged image of the indicator and scale). It was thus possible to read the deflection to 0·05 degree.

Calibration—The calibration was effected by means of a series of known weights of various values within the limits of the instrument's capacity, carefully noting the deflections. The zero reading was checked after each ten weighings and the calibration repeated after each fifty readings. In both cases any change was unnoticeable. A calibration curve was plotted and the actual weights in grams read off from it. These readings were also supplemented by checking the values so obtained by calculation.

Possible Variation of Balance with Humidity and Temperature Changes—The balance was used in a room maintained at constant temperature throughout. Frequent readings were taken of the temperature to detect any possible variation, but this was found to be unnecessary. A correction had to be made for the change in weight of the fibres due to the humidity of the atmosphere in the room. Observations of wet and dry bulb temperatures were taken close to the apparatus throughout the course of the experiment.

Preparation of Fibres before Weighing

Measurements with the projecting microscope are made on fibres mounted in Canada balsam, and as previously shown (Publication No. 11, p. 34) in this medium the diameter obtained is that of the clean dry fibre. Thus to compare the two methods the fibres to be weighed must be free from adhering greasy matter, and the dry weight of the fibre employed for the diameter calculations. The fibres to be weighed were therefore extracted with alcohol and well rinsed in distilled water. A special fibre cutter was made by means of which the fibres could be cut exactly to a known length. This consisted of two knife edges (safety razor blades) which could be brought down between two sets of rubber pads between which the fibre was held under just sufficient tension to straighten it, but not to extend it by any stress. The distance between the knife edges could be accurately determined. The method was thoroughly tested by dealing with some hundreds of fibres of different diameters and thickness. Finally, a complete test by both weighing and microscopic methods was applied to Botany wool fibres from

a top of 70's quality. They were left in the atmosphere for some time before weighing in order to obtain equilibrium with the humidity of the room, and then weighed individually on the micro-balance, after cutting to the desired length. They were immediately mounted on a microscope slide in Canada balsam in the same order as for weighing, and their diameters measured at ten points along their length by the projecting microscope method, magnification 1,000 diameters (*J. Text. Inst.*, 1924, **15**, T334, and Assoc. Report, No. 11, p. 17).

Method of Calculation

Assuming a cylindrical structure* the weight of a dry fibre of—

$$\text{Length} = l,\quad \text{Density} = \Delta,\quad \text{Diameter} = d,$$

is given by—

$$W = \frac{\pi \Delta d^2 l}{4} \qquad \text{A}$$

W is known from the micro-balance, $\Delta = 1{\cdot}30$, and l was taken as 7·80 cms. throughout. The latter is a purely arbitrary value suited to the length of the fibres under test. In the present work the fibres are not measured dry, but conditioned.

From formula A we get—

$$d^2 = \frac{4W}{\pi \Delta l}$$

If R is the regain and W_R the weight of the conditioned fibre, then the dry weight of the fibre is—

$$\frac{100 W_R}{100+R}$$

Therefore for dry fibres $d^2 = \dfrac{400\ W_R}{\pi \Delta l\,(100+R)}$

$$\text{or } d = \sqrt{\frac{400\ W_R}{\pi \Delta l\,(100+R)}} \qquad \text{B}$$

The values taken for the regain at the various humidities were those as obtained by Shorter and Hall (Publication No. 39), and for the density of wool (dry) that given by King (Publication No. 19), namely, 1·30. In the case of the appended tables, the individual weights of the fibres were taken, added together, and the average taken. Since d^2 is proportional

* Actually the cross section of wool fibre is slightly elliptical, and if d_1 and d_2 are the major and minor axes respectively—

$$W = \frac{\pi \Delta d_1 d_2 l}{4}$$

but unless d_1 and d_2 are very different, $d_1 \times d_2$ is sensibly the same as d^2. In measuring mounted fibres with the projecting microscope, the chance of measuring at the major or minor axis respectively is very small, and the average value obtained will naturally approximate to the mean of the two.

to W, this is equivalent to obtaining the root mean square of the diameter as shown below.

$$W = \frac{\pi d^2 l \Delta}{4} \text{ for dry fibres.}$$

For constant length $\frac{\pi l \Delta}{4}$ is constant, say $= K$.

Then from above $W = Kd^2$.

Now if n fibres are taken of weights—

$$W_1, W_2, W_3, W_4 \; . \; . \; . \; . \; . \; . \text{ to } W_n$$

and corresponding diameters—

$$d_1, d_2, d_3, d_4 \; . \; . \; . \; . \; . \; . \; . \; . \; . \text{ to } d_n,$$

we have, if W_m = mean weight of fibre.

$$W_m = \frac{W_1+W_2+W_3+W_4 \; . \; . \; . \; . \; W_n}{n}$$

Now mean square diameter $= d_m{}^2$ is equal to—

$$d_m{}^2 = \frac{d_1{}^2+d_2{}^2+d_3{}^2+d_4{}^2 \; . \; . \; . \; . \; d_n{}^2}{n}$$

$$\text{also } W_m = \frac{Kd_1{}^2+Kd_2{}^2+Kd_3{}^2+Kd_4{}^2 \; . \; . \; . \; . \; . \; . \; Kd_n{}^2}{n}$$

$$i.e. \; W_m = \frac{K\,(d_1{}^2+d_2{}^2+d_3{}^2+d_4{}^2 \; . \; . \; . \; . \; . \; d_n{}^2)}{n}$$

or substituting from above—

$$W_m = Kd_m{}^2,$$

or $\qquad W_m$ is proportional to $d_m{}^2$.

In deducing relationships between fibre diameter and quality, other observers have taken the *arithmetic* mean diameter as their basis. The square root of the mean of the squared diameters is, however, the correct value to employ. As an example, the appended table gives the arithmetic mean diameter as $2{\cdot}134 \times 10^{-3}$ cm., and the root mean square diameter as $2{\cdot}166 \times 10^{-3}$ cm. This, of course, is only identical with the arithmetic mean, when the fibres are all of the same diameter (*i.e.* when the standard deviation is *nil*), and becomes greater than the arithmetic mean, the less uniform the fibres are in thickness. This point can be discussed more conveniently in connection with the general results on fibre measurement, which it is hoped will shortly be published.

The actual measurements of the 70's top taken by the projecting microscope were recorded, the squares of the diameters calculated, added together, the mean taken, and the square root of the mean value extracted. It was found that the average value of the diameter, as estimated by the micro-balance, is $2{\cdot}164 \times 10^{-3}$ cms., and by the micrometric method as $2{\cdot}166 \times 10^{-3}$ cms. The two methods are therefore in good agreement in this case. There is also confirmation of the value 1·30 for the density of dry wool assumed in this paper. The coefficient of variation in the case of the micro-balance was 13·75% and the standard deviation 0·1904, whilst with the projecting microscope the coefficient of variation was 17·25% and the standard deviation 0·3681.

The balance averages a whole fibre, while the microscope gives measurements at a number of points. Under the conditions shown in the following

table it is seen that the micro-balance is a reliable instrument for the diameter determination of fibres—

Table I.

Table of Results showing Comparison of Methods

Relative Humidity 88%. Regain 22%. Temperature 56·8° F.

No.	Wt. in Scale Divisions	Diameter from Photo-Micrometer ($\times 10^{-3}$ cms.)	Squares of Diams.	No.	Wt. in Scale Divisions	Diameter from Photo-Micrometer ($\times 10^{-3}$ cms.)	Squares of Diams.
1	2·0	2·255	5·085	26	2·0	2·235	4·996
2	2·1	1·735	3·010	27	2·1	2·890	8·352
3	2·0	1·780	3·168	28	2·2	2·320	5·383
4	1·0	1·500	2·250	29	1·3	2·170	4·710
5	1·7	1·660	2·755	30	2·0	2·730	7·454
6	2·7	2·465	6·075	31	2·9	2·620	6·864
7	3·0	2·640	6·969	32	2·1	2·235	4·996
8	2·0	2·175	4·732	33	2·2	2·210	4·884
9	1·6	2·255	5·089	34	1·7	1·870	3·496
10	1·0	1·825	3·332	35	1·6	1·700	2·890
11	3·0	2·720	7·399	36	2·1	2·010	4·040
12	1·9	1·750	3·062	37	2·4	2·180	4·753
13	1·7	2·455	6·029	38	2·0	2·095	4·389
14	2·7	1·960	3·842	39	1·8	2·100	4·410
15	2·4	2·310	6·335	40	2·0	1·855	3·442
16	1·5	2·550	6·501	41	1·4	2·170	4·710
17	3·2	1·600	2·560	42	1·9	1·910	3·648
18	1·9	2·520	6·351	43	1·4	1·955	3·821
19	2·0	2·180	4·753	44	1·7	2·150	4·622
20	1·7	1·810	3·276	45	1·5	1·690	2·856
21	3·0	2·762	7·628	46	1·6	2·040	4·161
22	3·1	3·080	9·488	47	1·7	1·825	3·332
23	1·6	1·955	3·821	48	1·3	2·290	5·243
24	1·7	1·430	2·045	49	1·1	1·780	3·168
25	1·7	1·975	3·901	50	1·4	2·335	5·453

Mean Weight in Scale Divisions = 1·952

Hence Diameter, using micro-balance (Formula B, page T70), $= 2{\cdot}164 \times 10^{-3}$ cms.

Mean Square of Diams. = 4·691

Hence Diameter, using microscope, calculated from mean square $= 2{\cdot}166 \times 10^{-3}$ cms.

Arithmetic Mean Diameter from Table I $= 2{\cdot}134 \times 10^{-3}$ cms.

Diameter of Medullated or Kempy Fibres

In this case the results obtained by the two methods cannot be compared so simply since the diameters obtained from the micro-balance assume a fibre to be solid and of uniform density, whereas the medulla portion is more or less of honeycomb structure. Thus, the diameter calculated from the specific gravity 1·30 is considerably less than the observed diameter obtained by the project microscope, the difference increasing with the proportion of medulla. The two methods, however, allow an approximate determination to be made of the relative proportions of medulla, air space, and solid wool substance contained in the fibre. Assuming that the actual substance of the medulla (excluding the air or gas) is of the same density as wool, the proportion of air or gas in the medulla and in the fibre as a whole is given in Table II, the last two columns. The mathematical details and formulæ appear in the Appendix.

The following procedure was adopted. A large number of Scottish Blackface fibres, which had been specially selected on account of their large medulla content, were weighed on the micro-balance. The weights

were carefully recorded and each fibre given a number. They were next mounted on microscope slides in the same order as that in which they were weighed. The external diameter and the diameter of the medulla core were measured on the photo-micrometer at ten places on each fibre, both measurements being made at the same time along the same diameter of the fibre. The results obtained from measurements of 150 fibres are not conclusive and further work is necessary. Nevertheless they are interesting and important. By calculation from the formulæ it is found that in medulla fibres of the type taken—

(1) The percentage volume of air space enclosed in the medulla is approximately between 50–60% of the total fibre volume.

(2) In the medulla itself the percentage of air space is about 90% by volume, so that the actual medulla substance only occupies about 10% of the medulla core.

(3) For fibres containing large quantities of medulla, allowance must be made, in deriving relations between diameter of fibre and count of yarn, for the fact that a kempy fibre is light in weight as compared with its diameter. Further work is projected to determine the density of the medulla substance, without which the other formula cannot be calculated accurately. The large percentage of air space in medulla probably accounts for anomalous effects in the dyeing of medulla-containing fibres.

(4) In cases where fibres are practically all medulla, with just a thin outer wall, the readings showed that the cross section was less circular with increase of medulla and the method could not be utilised in these cases. Tests therefore had to be confined to those cases where approximately circular medulla existed.

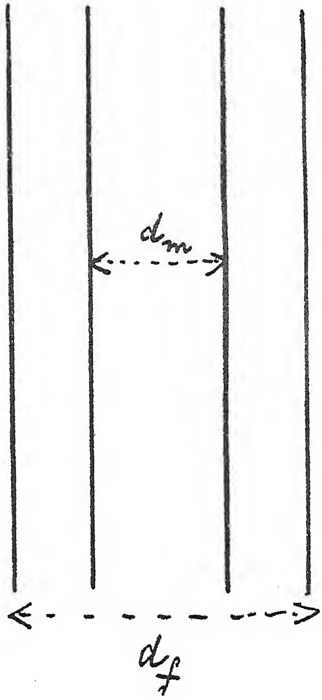
Table II., following, gives the results of experiment on ten typical fibres. It is seen therefrom that the mean percentage of air space to volume of medulla is 90·89%, and that of air space to total volume of fibre is 54·55%. Taking 40 fibres, the mean value of the former was 88·5% and for 120 fibres the value of the latter was 54·99%.

Table II.
Selected Scottish Blackface

No.	Fibre Diam. $d_f \times 10^{-3}$ cms.	Medulla Diam. $d_m \times 10^{-3}$ cms.	$(d_f^2) \times 10^{-5}$	$(d_m^2) \times 10^{-5}$	$d_f^2 \times 10^{-5}$ *from Micro-balance*	*Vol. air enclosed in Medulla*	% Air Space to Vol. in Medulla	% Air Space to Total Fibre Vol.
1	9·300	6·920	*8·68*	*4·79*	*4·40*	*26·046*	88·727	49·133
2	10·450	8·275	*10·92*	*6·84*	*4·23*	*40·100*	97·807	61·264
3	8·220	6·075	*6·75*	*3·69*	*3·26*	*21·389*	94·580	51·704
4	10·560	8·280	*11·15*	*6·85*	*4·52*	*40·632*	96·788	59·462
5	11·790	9·780	*13·90*	*9·56*	*6·01*	*48·354*	82·531	56·763
6	8·405	5·960	*7·06*	*3·55*	*4·11*	*18·080*	83·099	41·785
7	12·470	10·380	*15·55*	*10·77*	*5·10*	*64·043*	97·029	67·203
8	11·525	9·620	*13·28*	*9·25*	*4·76*	*52·215*	92·108	64·157
9	8·320	5·810	*6·922*	*3·376*	*4·05*	*17·601*	85·071	41·191
10	9·460	7·200	*8·949*	*5·184*	*4·22*	*28·982*	91·223	52·844
				Mean of 10 fibres	...	...	90·89%	54·55%
				„ 40 „	...	...	88·50%	—
				„ 120 „	...	...	—	54·99%

APPENDIX

Estimation of Medulla (calculations)



Suppose the fibre to be of cylindrical cross section. Let the outer, or fibre diameter, $= d_f$, and the inner, or medulla diameter, $= d_m$. These can both be measured. Then if Δ is the density of wool substance, and also assumed to be the same for medulla substance, namely, $\Delta = 1{\cdot}30$, and if l the length is constant (7·80 cms. in our experiments), we have—

Weight of whole fibre, if solid,=

$$\frac{\pi \Delta l (d_f)^2}{4} = W_f.$$

Now let the actual weight of the fibre from micro-balance $= W_b$.

From this figure a value d_b can be calculated which would be the diameter of a solid fibre of the same weight as the one taken, *i.e.* without medulla.

Thus $$W_b = \frac{\pi \Delta l (d_b)^2}{4}$$

and $$(d_b)^2 = \frac{4 W_b}{\pi \Delta l}$$

Now volume of whole fibre $= \dfrac{\pi l (d_f)^2}{4} = V_f.$

And since volume $= \dfrac{\text{Weight}}{\text{Density}}$ therefore

volume of the solid portion as calculated from micro-balance $(=V_b)$.

$$V_b = \frac{\pi l (d_b)^2}{4}$$

Therefore volume of air enclosed—

$$V_a = V_f - V_b = \frac{\pi l (d_f^2 - d_b^2)}{4} \quad . \; . \; . \; . \; . \; . \quad C.$$

Now the volume of medulla core—

$$V_m = \frac{\pi l (d_m)^2}{4}$$

Therefore percentage ratio of air enclosed in medulla core by volume—

$$\frac{V_a}{V_m} \times 100 = 100 \times \frac{\frac{\pi l}{4}(d_f^2 - d_b^2)}{\frac{\pi l}{4} d_m^2} = \frac{(d_f)^2 - (d_b)^2}{d_m^2} \times 100 \quad . \; . \; . \; . \quad C.$$

Percentage ratio of air enclosed to total volume of fibre by volume—

$$\frac{V_a}{V_f} \times 100 = \frac{d_f^2 \times d_b^2}{d_f^2} \times 100 \quad . \; . \; . \; . \; . \; . \; . \quad D$$

7—A TEST TO DISTINGUISH BETWEEN VISCOSE AND CUPRAMMONIUM ARTIFICIAL SILKS

By O. S. Rhodes, M.Sc.

This test depends for its application upon the fact that Viscose Silk invariably contains sulphur whereas cuprammonium silk is free from this element.

Reagent

A solution is made up containing 1% silver nitrate, 4% sodium thiosulphate, and 4% caustic soda. The silver nitrate, dissolved separately, is added to the sodium thiosulphate, also dissolved separately, and the precipitate which first forms redissolves. The caustic soda is now added and the whole brought to the boil and filtered.

Test

The two silks are separately immersed for 1 min. in the solution at boiling temperature. The cuprammonium silk remains white whereas viscose silk is coloured a deep red-brown, the difference between the two being very distinct. Dr. Kurt Götze (*Melliand's Textilberichte*, Oct. 1925, abstracted in the *Silk Journal*, 20th Nov. 1925), discusses a means of distinguishing between cuprammonium and viscose silks, and advocates heating with a 1% ammoniacal silver nitrate solution when cuprammonium silk remains white and viscose silk turns brown. The thiosulphate-silver solution gives, however, a very considerably deeper shade to the silk than the ammoniacal-silver solution.

The two tests were compared by boiling cuprammonium, viscose, vistra, and nitrate silks separately in the respective solutions for 1 min. Vistra silk is a variety of viscose thought to contain more sulphur. In order to express the depth of colour produced by these tests without reference to actual tested samples, the colourations obtained are expressed as though they were % dyeings of Chlorazol Brown M, the shade of which is very close to that produced by these tests. The colouration due to ammoniacal silver solution is perhaps a little yellower.

	Götze Test	Present Test
Cuprammonium Silk ...	0% Chlorazol Brown M	0% Chlorazol Brown M
Viscose	·3% ,, ,,	2·5% ,, ,,
Vistra	1% ,, ,,	4% ,, ,,
Nitrate	·6% ,, ,,	3·25% ,, ,,

It will be noticed that nitrate silk also gives a brown colouration with these solutions. The test may therefore be used to distinguish between cuprammonium and nitrate silks though its value as a means of distinction between cuprammonium and viscose silks is unaltered. Nitrate silk may also be identified by the characteristic blue colour reaction with diphenylamine sulphate.

Dr. Götze, in the article quoted above, also mentions the colouration given by nitrate silk and suggests that the colouration does not depend upon the sulphur content of the silk but is probably due to the precipitation on the fibre of a brown colloidal form of silver. He has probably overlooked the fact that in the manufacture of nitrate silk, denitration is effected by passing the silk through a bath containing alkaline sulphides, and it appears to the author that this is probably the source of a certain amount of sulphur left in the silk, which results in the colouration.

The thiosulphate silver solution is also employed as a test for oxycellulose, its use for this purpose being first described by W. Harrison, *J. Soc. Dyers and Colourists*, 1912, **28**, 361. Consequently, certain forms of cuprammonium silk, which are known to contain oxycellulose may respond to this test though the colouration would be of a greyer or less brown character. This fact also negatives the suggestion that the colouration is due to precipitation of brown colloidal silver, since in the oxycellulose test the deposit is grey.

The shades obtained by the use of ammoniacal silver solution, though increased slightly by longer boiling, do not approach those obtained by the present method. This is probably due to the fact that the caustic soda, being a strong base, dissolves the sulphur more rapidly than ammonia.

The present method is recommended as giving a much more satisfactory distinction between cuprammonium and viscose artificial silks.

The author is indebted to Messrs. Tootal Broadhurst Lee Co. Ltd. for their permission to publish these results.

8—THE REFLECTION OF LIGHT FROM TEXTILE MATERIALS AND THE PHYSICAL CAUSES OF THEIR LUSTRE

By George Alfred Rea Foster, B.A., A.Inst.P.

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I.—INTRODUCTION

The work summarised in this paper was suggested by the experimental researches of Adderley[2,3] and Oxley,[2] Barratt,[4] and Denham and Lonsdale,[5] upon the lustre of cotton and other textile materials.

Several suggestions have been put forward as to the causes of lustre in textiles, especially with regard to the high lustre of mercerised cotton. A summary of these was given by Adderley.[1]

Barratt,[4] as a result of a series of measurements of the reflection of light from cotton and mercerised cotton, states—"There seems to be little doubt that the lustre can be accounted for by a single surface reflection," and the object of this investigation was to test this view by applying the laws of reflection to the discussion of the reflection of light by the surfaces of textile fibres.

The work was in the first place undertaken in order to find an explanation of the correlation observed by Adderley[3] between the shape of the cross-sections of cotton hairs and the intensity of the light reflected by them, and so to disclose the cause of their lustre. It was found that the observed variation of the amount of reflected light could be explained by considering only external reflections from the surface of the hairs, and as a result of this the work was then extended to a general discussion of the conditions necessary for high lustre in textile materials.

Comparison of the further theoretical results with experiment showed that in some cases the reflection and scattering of the light from the inside of the hairs cannot be ignored, but that, as far as the lustre is concerned, sufficiently accurate and valuable conclusions may be drawn by dealing with external reflections alone.

An exact calculation of the reflection of light from textile materials requires mathematical methods and will be published elsewhere. This note will be confined to a simple discussion, in the next section, of the agreement between the calculated reflection from cotton hairs with Adderley's measurements, and then, in the final section, on the conditions for high lustre in textile materials, with special reference to cotton, a summary is given of those results of the work which are of practical importance.

II.—THE REFLECTION OF LIGHT FROM COTTON HAIRS AND THE GEOMETRICAL SHAPE OF THE HAIRS

In the work[3] on the lustre of raw cottons, the intensity or amount of the light reflected from pads prepared by laying the hairs as straight and parallel as possible in a thick layer on a plane surface was measured. This was found to be closely correlated with the ratio of the axes of the cross-sections of the hairs, the intensity of the light increasing as these axes became more nearly equal.

In order to find a theoretical explanation of this correlation it was necessary to take some ideal geometrical form, to which the actual shapes of cotton hairs approximate. The form chosen was the surface traced out by the boundary of an ellipse, when its centre moves uniformly along a straight line at right angles to the plane of the ellipse while its axes rotate.

The intensity of the light reflected from a pad of such ideal hairs can be calculated, and when only reflection from the external surfaces of the fibres is considered, it is found under the conditions of the above experiments to be proportional to the following expression—

$$\frac{1}{a.c}\left[\frac{(a/b)^2+1}{(a/b)^2-1}\right]$$

in which c is the number of convolutions per unit length, and a and b are the greatest and least axes of the cross-sections.

In comparing this with the experimental results, the mean value of a for each cotton was obtained from Adderley's original measurements of the cross-sections of the hairs, the measurements of 200 sections of each cotton being used. The average of the quantity in brackets was calculated from the same observations and the number of convolutions was counted on centimetre or two centimetre lengths of 50 to 80 hairs taken at random from each cotton.

The results are given in Table I. and the theory is compared with experiment by dividing the values of the above expression by the corresponding observed intensities of the reflected light to give the figures in the last column. If the theory is correct, these ratios should be constant, but in judging them the experimental error must be taken into account. Their probable errors cannot be calculated accurately, but they are certainly not less than 6%. Most of the cottons give a reflection which is, within the limits of error, in accord with the theory, and considering the departures

Table I.

Variety of Cotton	Observed Intensity of Reflected Light I	Mean Ribbon Width in cms. a	Mean Number of Convolutions per cm. c	$\frac{(a/b)^2+1}{(a/b)^2-1}$	$\frac{1}{I.ac}\cdot\frac{(a/b)^2+1}{(a/b)^2-1}$
American F.G.M. ...	5·7	·00223	31·3	1·71	4·3
Peruvian	6·7	226	30·0	1·60	3·5
Queensland	6·7	229	27·8	1·50	3·5
Sakel S.	7·1	184	29·8	2·08	5·3
St. Kitts Sea Island ...	7·7	165	30·6	1·92	4·9
289 F.	7·8	195	30·6	1·64	3·5
Surat	7·8	254	21·1	1·68	4·0
U.S.12 Sea Island ...	7·9	197	32·6	2·04	4·0
Abassi	8·0	201	30·9	1·99	4·0
Texas	8·1	227	29·3	2·11	3·9
Barbados Sea Island	8·2	169	31·4	1·94	4·5
V.135 Sea Island ...	8·7	162	33·8	2·01	4·2
Sakel C.R.	8·8	189	29·8	2·05	4·1
Sample M.	9·0	207	30·5	2·00	3·5
Antigua Sea Island ...	10·7	175	29·9	2·52	4·5
				Mean ...	4·11

of some of the cross-sections from the elliptical shape, the few large deviations are not surprising. The consideration of external reflections alone

is therefore practically sufficient to give an adequate account of the variation of the intensity of the reflected light with the geometrical shape of cotton hairs.

According to the theory the variation of the intensity of the reflected light with the shape of the sections is due to the presence of the convolutions; if the hairs are not convoluted the reflection would not vary in the same manner. At first sight the above formula may appear to disagree with the observed absence of correlation between the reflection and both the number of convolutions and the diameter of the hairs. This absence of correlation is, however, only apparent, and is due to the small variation in these two quantities being masked by the far greater variation in the shapes of the cross-sections.

III.—THE CONDITIONS WHICH FAVOUR HIGH LUSTRE IN TEXTILE MATERIALS

The last section dealt with the reflection of light from prepared pads of parallel cotton hairs. Since it is upon the reflecting properties of such pads that the lustre of the finished textile product partly depends, the conclusions (many of which have already been proved by experiment) derived from the theoretical investigation of these properties will first of all be discussed.

If a pad of fibres is held between the eye and a source of light in such a position that the light is reflected from the surface of the pad into the eye and with the fibres perpendicular to the direction of vision, the intensity of the reflected light is practically the same whatever angles the incident light and the direction of vision make with the surface of the pad and the surface has not a lustrous appearance.

When, however, the fibres are parallel to the plane containing the incident light and the direction of vision, or the plane of incidence, the reflected light is greatest when these two directions make equal angles with the surface of the pad. In this position the light is said to be specularly reflected and the lustrous appearance of the surface of the pad is due to the reflection in this direction being greater than that at other angles. In this paper the word lustre will be used to describe the property of a surface of reflecting more light in one particular direction and must therefore be clearly distinguished from the intensity or amount of reflected light. The lustre depends upon the way in which the intensity of the reflected light changes when the angles of incidence and reflection are varied, and the greater the specular reflection as compared with that at other angles the greater the lustre of the surface. A pad of fibres, then, always has a low lustre when viewed in a direction perpendicular to the direction of the fibres, and may have a high lustre when it is looked at along the direction of the fibres. It is this lustre of the pad when the fibres are parallel to the plane of incidence which determines the lustre of the finished product.

It is therefore necessary to consider the influence of the arrangement and properties of the fibres upon the lustre in this position. In the first place, since all the fibres cannot be in the plane of incidence unless they are straight and parallel to one another, the maximum lustre of which they are capable is only obtained when the fibres are as straight and parallel as it is possible to make them. The lustre is also obviously limited by the lustre of the surfaces of the fibres themselves, which is determined by the

smoothness or degree of polish of these surfaces. After this it depends almost entirely upon the geometrical shape of the fibres.

The fibres of greatest lustre are those which, like silk and artificial silk, are free from convolutions and folds in their surfaces and are therefore cylindrical. Their cross-sections, however, are not necessarily circular. With perfectly smooth cylindrical fibres, all the light reflected in the plane of incidence is specularly reflected and the lustre is a maximum. When the fibres are not cylindrical the lustre is less and decreases as the fibres depart more and more from the cylindrical form, that is, as the curvature of their surfaces in directions parallel to their axes increases.

High lustre in convoluted cotton hairs is therefore produced by those conditions which make the hairs approach most closely to a cylindrical form. These are—

(1) Low maximum diameter or ribbon width.
(2) Low number of convolutions per unit length.
(3) Low ratio of the axes of the cross-sections.
(4) Uniformity in these three quantities.

It will be noticed that these conditions are also those which determine high specular reflection, the variation of which with the shape of the hairs was discussed in the last section. The third factor has by far the most influence upon the lustre, partly because the variation in the shape of the cross-section between the different varieties of cotton is considerably greater than that of the number of convolutions or of the ribbon width, and partly because as the ratio of the axes approaches unity the lustre increases extremely rapidly. But the other factors should not be ignored. It must also be noticed that, when either there are no convolutions or the axes are equal, the hairs are cylindrical and the remaining factors have no influence upon the lustre. In these limiting cases the formula given on p. T78 no longer holds.

Any process, therefore, which decreases the ribbon width, removes convolutions and improves the shape of the cross-section, will increase the lustre of cotton. These are precisely the effects of mercerisation under tension and the high lustre of mercerised cotton is thus accounted for. The ratio of the axes for mercerised cotton is about 1·6 to 1·5, and slight improvements in the shape of the section would produce increasing improvements in the lustre. Thus, other things being equal, a change in a/b from 1·5 to 1·2 would approximately double the intensity of the specularly reflected light.

The lustre of a surface made up of a series of parallel single yarns laid side by side on a plane is the same as that of a fabric composed entirely of floating threads, and is therefore of importance in dealing with the lustre of fabrics. It might at first sight appear that the lustre of such a surface would be greatest when the plane of incidence is parallel to the direction of the fibres on the upper surface of the yarn. The problem, however, is different from that of parallel fibres already discussed, since the fibres on the surface of the yarn are curved. Calculation shows that the lustre is greatest when the pad of yarns is viewed in a direction parallel to the axes of the yarns. This lustre decreases as the twist in the yarns is increased and is, for the same angle of twist, independent of the diameters of the hairs and of the yarns, except so far as the diameter of the hairs affects the lustre of the raw material. Further, the lustre of the yarns cannot exceed the lustre of a pad of parallel hairs.

Except when the angles of incidence and reflection to the surface of the pad are nearly equal, the amount of light reflected from these floating threads is a maximum when they are perpendicular to the plane of incidence and a minimum when they are in the plane of incidence. This fact is, of course, made use of in weaving those fabrics in which patterns are produced by floating threads. It will be noticed that when the angles of incidence and reflection are equal, the pattern is almost invisible. The important fact from the present point of view is, however, that the contrast between the warp and weft faces is increased by increasing the lustre of the yarns.

Finally, in order to prevent misunderstanding, it must be remarked that very high lustre in the finished fabric is not always desirable. Much depends upon what may be called the character of the lustre. Thus, Barratt[4] points out that on account of the interlacing of the yarns in some fabrics, the surface appears as a series of bright points on a darker ground, and "it is to this distribution of the points of high light that some lustrous cotton fabrics owe their beauty." This breaking up of the light must involve a reduction in the magnitude of the lustre, but the contrast between the bright points and the remainder of the surface increases with increase in the lustre of the yarns themselves and therefore in the lustre of the raw material.

IV.—SUMMARY

(1) The results of a theoretical investigation of the lustre of cotton and mercerised cotton are discussed.

(2) In the first place the theory shows that the observed variation of the intensity of the light reflected from raw cottons with the geometrical shape of the hairs may be accounted for by single surface reflections.

(3) The lustre of textile fibres depends upon the lustre of the surfaces of the fibres themselves and upon the shape of the fibres. The fibres of maximum lustre are those which are cylindrical and the lustre decreases as the fibres depart from the cylindrical form.

The factors which determine the lustre of raw cotton are discussed.

(4) The lustre of the finished product cannot exceed the lustre of the raw material in the form of a pad of parallel hairs, and the maximum lustre is only obtained when the hairs are laid straight and parallel. The lustre of single yarns thus decreases with increase in the twist.

(5) The variation of the lustre of yarns with the position of the plane of incidence is considered and the results are applied to a brief discussion of the lustre of fabrics.

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9—THE TIME FACTOR IN HAIR TESTING

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INTRODUCTION AND SUMMARY

The breaking load of a cotton hair does not depend entirely on the strength of the hair, but varies a great deal with the rate at which the tension is increased or rather with the time allowed for the hair to stretch to the breaking point. The more time the hair is given to yield, the lower is its resistance at any given extension or at rupture, owing to the fact that its elasticity is imperfect. To enable comparison to be made between tests carried out at different rates and to determine the best rate for testing, this time effect must be known quantitatively. There are other factors also which may lead to different results of breaking load tests on similar samples, namely, errors in the instruments and changes in atmospheric humidity.

Tests at rates of loading between 0·003 and 1 gram per second were carried out on a modified type of O'Neill hair-strength tester, designed to avoid several errors to which the usual type is subject. Instead of water, the liquid used to control the tension was a solution giving a definite relative humidity (66% in these experiments). The samples were conditioned over the same solution before testing. The dimensions of the apparatus were standardised to give a suitable calibration constant and rate of loading, and to minimise a correction necessitated by the extension of the hair. To avoid the error involved in guessing when the hair just comes under tension, the upper grip was on a lever by which an extremely small but definite tension was obtained at the beginning of an observation.

For higher speeds, a Torsion Balance hair tester was used, with a moving arm made extremely light to avoid jerky tensions. It was operated by hand to the beat of a metronome, at rates of loading from 1·4 to 3·6 grams per second. Similar specimens were tested on the two instruments at speeds so close that no appreciable time effect was to be expected, and a comparison of the frequency curves gives little indication of error in the more rapid machine.

As random variations among individual hairs might obscure the time effect, special precautions were taken in sampling, which was also controlled by measurements of hair weight and rigidity. These showed that the hairs broken at the different speeds were on the average very similar. The variety studied most thoroughly was a fine Sakel cotton, and the effect was also measured on a mercerised Sea Island, a rough Peruvian, and New Guinea Durango (Upland class).

At the lower rates of loading, the breaking load increases considerably, that of Sakel changing from 4·09 to 5·58 gm. within the range of the O'Neill tester. Beyond a rate of 1 gram per second there is no sure indication of

any change. Between the usual rates on the two testers (say 0·1 and 2·0 grams per second) the difference is about 20%. As this varies with the cotton, it is desirable that the difference should be diminished by testing on the O'Neill instrument at 0·5 gram per second, on the Torsion Balance at 1·5 to 2 grams per second. Quick testing has the advantage not only of saving time, but also of giving a result closer to the upper limit, which has more absolute significance than values which depend as much on the speed as on the specimen.

An approximation to the lower limit of breaking load was made by hanging weights of 2·13 grams on a number of Sakel hairs, half of which broke in 30 days. As a general principle, when the method of testing varies, the samples being similar, comparison is sounder on the basis of the order of individual results, median to median, &c., rather than on the magnitude of deviations, mean to mean. The change in breaking load was thus followed for weak and strong hairs separately for breaks occupying from one-third of a second to a month. A simple and general expression is obtained by plotting the breaking load against the time occupied in loading to rupture—when the time is divided by 10, the breaking load increases by a constant amount (roughly one-tenth of the breaking load for a time of 10 seconds).

The change of breaking load is explained as an effect due to elastic imperfection, and the empirical law can be directly related to a similar law for the decrease with time of the load on a thread kept at a constant extension. Extreme limits can be set to the increase and decrease of breaking load with time, showing that the above logarithmic law can only be regarded as a convenient approximation over the range of experiment.

Stronger hairs of a variety appear to be affected more than weaker hairs, and this would be expected if the internal thickening of the hair wall is less perfectly elastic than the surface layers.

EXPERIMENTAL METHODS

Modified O'Neill Instrument

For measuring the breaking load of single cotton hairs at moderate speeds the simple but delicate instrument designed by O'Neill[4] was used, with a few modifications designed to avoid errors which affect the result of measurements on the usual form.

Dimensions—Since a cotton hair extends about 7% of its length before breaking, the float sinks by this amount and this exaggerates the breaking load.

Let—

Breaking load $=F$ gms.	Inner diameter of tube $=a$ cm.
Length of specimen $=l$ cm.	Outer diameter of float $=b$ cm.
Extension at break $=el$ cm.	Height of liquid at zero $=h_0$ cm.
Density of liquid $=\rho$ gm./cc.	,, ,, ,, break $=h$ cm.

Then the volume of liquid run off and measured,

$$V=\frac{\pi}{4}(a^2-b^2)\left(h_0-h+el.\frac{b^2}{a^2-b^2}\right)$$

The load $F=\frac{\pi}{4}\rho b^2(h_0-h-el)$

$$=\frac{\rho b^2}{a^2-b^2}.V.\left[1-\frac{el}{F}\cdot\frac{\pi a^2b^2\rho}{4(a^2-b^2)}\right] \qquad (1)$$

$=$factor $\times$ reading $\times$ (1 $-$ correction).

The correction can be calculated if e/F be taken as 0·01 at about 60% R.H., a value obtained from figures given by Barratt.[1]

The error due to hair extension is generally neglected but may be several per cent. unless the dimensions are chosen to reduce it.

The following dimensions are given as their adoption would make results more accurately comparable—

Inner diameter of tube (*a*) 4·5 to 5·0 cm.; length about 30 cm.
Outer diameter of float (*b*) 1·0 to 1·2 cm.; length about 15 cm.
Free length of mounted hair (*l*) 1·0 cm.

Longer specimens increase the probability of flaws and vitiate comparison of long with short hairs by approaching the tips of the latter.

Solution—When the hairs are broken over a free surface of water, their moisture content may correspond with anything from saturation to the humidity of the laboratory. Any errors that might arise from varying moisture content were avoided by conditioning overnight the test sample of hairs over a 40% solution of calcium chloride (density 1·272 at 15° C.), and using the same solution instead of water in the O'Neill apparatus.

Upper Grip—Perhaps the greatest source of error in the ordinary form of this apparatus is due to the difficulty of estimating the beginning of tension on the specimen. Ordinary hairs are so fragile that a "slight" tension as judged by eye may be a very appreciable fraction of the breaking load, and it was found impossible to test tendered hairs without the new type of upper grip shown in Fig. I. Essentially this consists of a small lever, whose

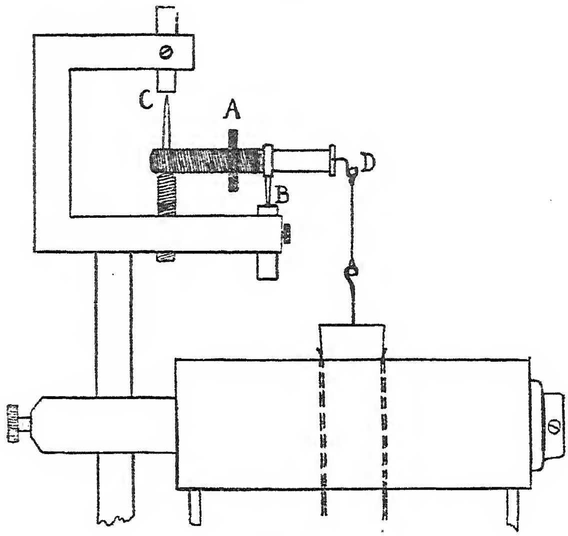


FIG. 1

moment can be adjusted by the nut A, mounted on two small needles B, which rest in point and line depressions on the stand, a third needle coming to rest against a plane C when a very slight tension is placed on the specimen. Owing to the downward movement of the grip and the delicacy of the lever it can easily be held in balance so that the release of two drops of the solution is sufficient to pull it over, with a tension of about 0·005 gram.

The grip D can be made to take paper mounts or torsion pendulums (small transverse rods). The latter were used in this research, as a preliminary measurement of rigidity[5] gives a measure of the fineness of each hair and a control on the sampling, with no great addition of labour.

The rate of loading is measured by the volume emitted in a fixed time (from Equation 1) and was varied by modifying the jet of the outlet tube,

capillary tube being used for the slowest rate. As it took about half an hour to break a hair at this rate, the top of the apparatus was completely enclosed to maintain the conditions of humidity.

Torsion Balance Instrument

With rates of loading above 1·0 gram per second, the interval between rupture and closing the jet may become appreciable in comparison with the total time of break, introducing a systematic error. For greater speeds, therefore, a Torsion Balance Hair Tester was employed, a modification of that used by Farrow and Neale.[3] The results from this instrument may be subject to an uncontrollable error due to oscillations of the beam, but these can be minimised by reducing the moment of inertia of the beam. In the present instrument the latter is a light duralumin pointer with a loading arm fixed at an angle 25° above the line of the pointer. The inertia is very small and the scale open and even over the usual range of testing. A constant rate of loading was maintained with the aid of a metronome.

Sampling

The variety tested most thoroughly was a high-grade Egyptian, Govt. No. 30 Ex. Super Sakel, and the following method of sampling was adopted. From the fairly large sample available, small tufts of hairs were taken at random from all parts and thoroughly mixed by repeated drawing and doubling. This in turn was reduced in bulk by a similar process and cut to a length of 15 mm. From this sample, single hairs were taken at random and counted out into bundles of twenty, fifty in all, which were weighed on a sensitive micro-balance (1 cm. deflection=0·0118 mgm.). The bundles were grouped into five lots of 200 hairs, so that the mean hair weight of each lot was approximately the same.

The hairs were mounted on torsion pendulums by molten shellac,* conditioned overnight over a 40% solution of calcium chloride (which gives 66·3% R.H. at 20° C.), and their rigidity determined before breaking on the O'Neill apparatus. Each lot was broken at a different rate of loading, but the rigidity was measured under the same conditions in each case. It had previously been found that a fairly high correlation (around 0·6) exists between the square root of the rigidity of single hairs and their breaking load, so that the approximate constancy of the mean rigidity shows that the lots would have given very nearly the same breaking load if broken under the same conditions.

The samples for the Torsion Balance were taken from the same final sample in the same way and mounted on paper grips, the weighing and rigidity measurements being omitted as the sampling was shown by the former lots to be sufficiently constant.

In the case of the Sea Island cotton, the sample consisted of the hairs of median length from a lightly combed seed. These were mercerised, cut to a length of 15 mm., and counted out one by one into bundles of 30 hairs, two of which were tested at each rate, with the rigidity control test.

Peruvian Full Rough was chosen as a good example of thick-walled hairs. New Guinea Durango is a type of Mexican cotton usually classed

*In one set of 200 tests, the mean breaking load of those hairs which broke within 1 mm. of the ends was separately evaluated and found to be slightly, though not significantly, greater than that of the remainder. Shellac melts below 80° C. and there seems no real danger of weakening the hairs by this method of mounting.

as an Upland. The samples were made as for the Sakel but the weight and rigidity control dispensed with, except on the lot tested at 0·098 gram per second.

EXPERIMENTAL RESULTS

The following tables show the mean values obtained on each of the samples examined—

Table I. (A)

Govt. No. 30 Ex. Super Sakel. 200 specimens at each rate.

Rate of Loading gm./sec.	Hair Weight mgm./cm.	$\sqrt{\Gamma}$ (dynes·cm.^{2})$^{\frac{1}{2}}$	Breaking Load grams
0·0029	0·00139	0·120	4·09±0·08
0·098	0·00139	0·113	4·67±0·10
0·324	0·00139	0·115	5·07±0·11
0·665	0·00139	0·117	5·50±0·10
0·986	0·00139	0·118	5·58±0·12
*1·43	—	—	5·44±0·11
*2·46	—	—	5·48±0·11
*3·57	—	—	5·29±0·11

Table I. (B)

Sea Island U.S. 12. Mercerised at constant length (52° Tw. NaOH at 15° C.). 60 specimens.

Rate of Loading	Hair Weight	$\sqrt{\Gamma}$	Breaking Load
0·0029	0·00241	0·242	6·33±0·14
0·104	0·00239	0·231	7·54±0·23
0·317	0·00239	0·235	7·94±0·23
0·672	0·00232	0·226	8·83±0·29
0·994	0·00232	0·222	8·98±0·22

Table I. (C)

Peruvian Full Rough. 200 specimens.
Hair weight per cm.=0·00236 mgm., $\sqrt{\Gamma}$=0·220.

Rate of loading	0·10	0·65	*1·22	*3·12
Breaking load	7·81±0·19	8·56±0·19	8·98±0·22	8·94±0·20

Table I. (D)

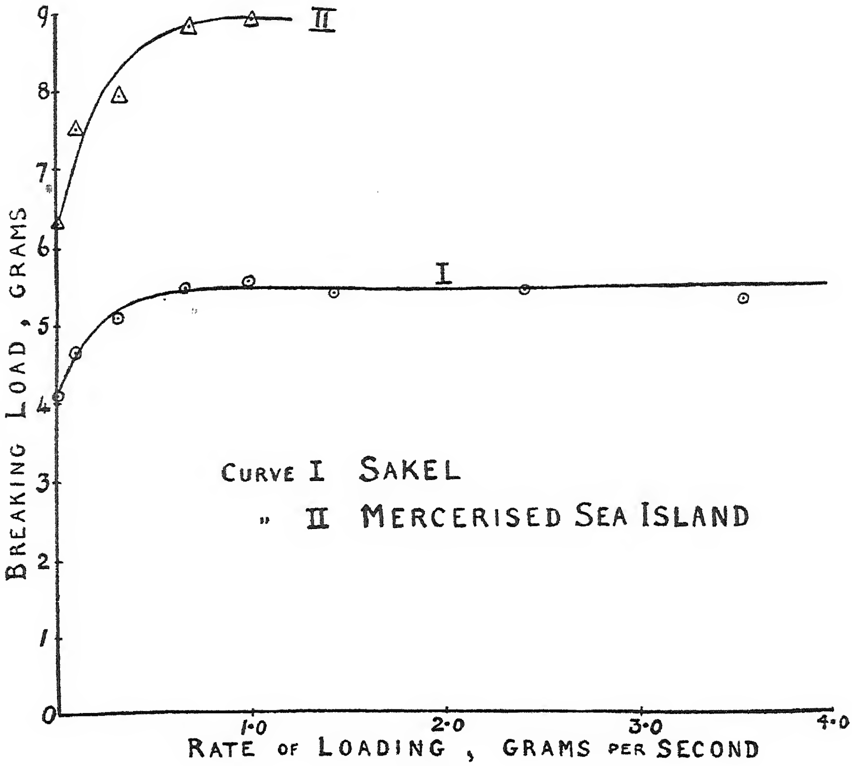
New Guinea Durango. 200 specimens.
Hair weight per cm.=0·00170 mgm., $\sqrt{\Gamma}$=0·145.

Rate of loading	0·098	0·65	*1·22	*2·08	*3·37
Breaking load	4·28±0·16	4·70±0·10	5·01±0·12	5·39±0·13	5·68±0·14

* On Torsion Balance tester.

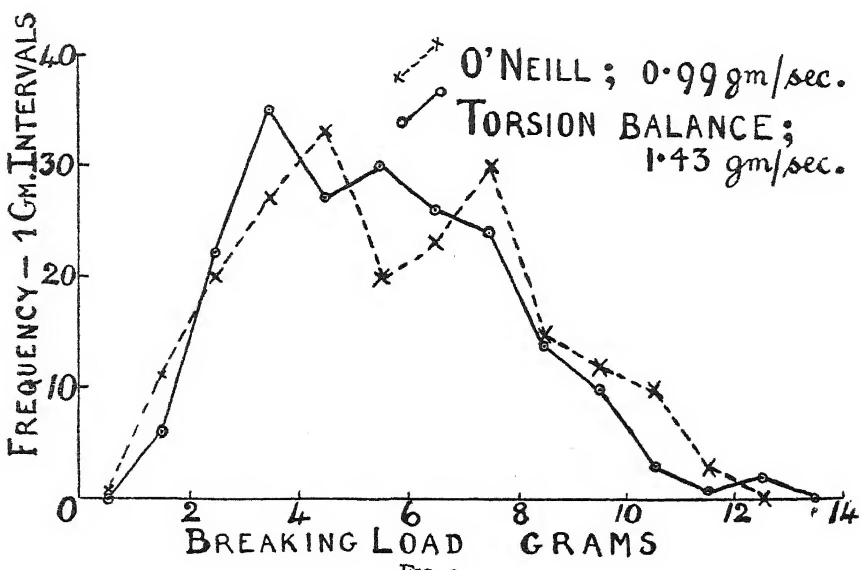
The breaking load of the Sakel cotton hair is plotted against rate of loading in Fig. 2, Curve 1. At slow rates the change is very considerable, the apparent strength increasing by 34·5% on increasing the rate from 0·0029 gm./sec. to 0·665 gm./sec. Over the same region the mercerised hairs show an increase in breaking load of 39·5%. Beyond this point these curves do not show any significant change. Only with the New Guinea Durango does the apparent strength continue to increase up to the highest rate.

There remains just a possibility that the apparent strength may be slightly diminished by vibratory stresses in the Torsion Balance tester. In Fig. 3 the frequency polygons of breaking load of the Sakel at the rates 0·986 and 1·43 gm./sec. are compared, and they appear to approximate to very much the same smooth curve. If any error is introduced by momentum in the latter, it is too small to raise any objection to the use of the Torsion Balance tester for ordinary testing purposes. though sufficient to obscure



9
8
7
6
5
4
3
2
1
0
II
I
1·0
2·0
3·0
4·0
BREAKING LOAD, GRAMS
RATE OF LOADING, GRAMS PER SECOND
CURVE I SAKEL
" II MERCERISED SEA ISLAND

FIG. 2



40
30
20
10
0
2
4
6
8
10
12
14
FREQUENCY – 1 GM. INTERVALS
BREAKING LOAD GRAMS
O'NEILL; 0·99 gm/sec.
TORSION BALANCE; 1·43 gm/sec.

FIG. 3

a slowly increasing trend at high speeds. The slightly lower value at 3·57 gm./sec. is almost certainly due to vibratory stresses introduced by the excessive speed in a proportion of the tests.

A Standard Rate of Testing

Though all the varieties show this effect of speed, they do not all vary to the same extent; the relative strength of the Sakel and Durango hairs changes greatly and even reverses with rate of loading, similarly with the other two. From the shape of the curves it seems desirable to test as fast as is consistent with accuracy. It is suggested that a rate of loading of 0·5 gm./sec. should be adopted for the O'Neill test and 2·0 gm./sec. for the Torsion Balance test. The result of the latter would then be about 9% greater than that of the former, and this some 10% greater than the result of the usual O'Neill test at about 0·1 gm./sec.

It appears that a greater degree of significance for the result and a more accurate comparison between results of different observers, as well as economy of time, are secured by testing at the higher speeds, and the use of the Torsion Balance tester is strongly supported. Nor should it be forgotten that the strains which break cotton hairs in practice are generally applied rapidly.

The Time of Break

From the point of view of testing routine, this effect must be considered as a relation between rate of loading, the testing condition, and mean breaking load, the result, and this is now satisfactorily defined. As a property of the hair, the effect is, however, not suitably described by these quantities. It is really a time effect of elastic imperfection and the most convenient way to express the time variable, a question which will be more fully discussed in a paper on the corresponding effect in yarns, is by the logarithm of the time between the beginning of loading and rupture.

When different materials are tested in identical ways, the mean values give the most significant comparison. When similar samples are tested in different ways, this is no longer so. Strong and weak hairs may be affected differently, *e.g.* the lower values may be crowded together, the higher ones opened out, and the means will then refer to very different specimens. Provided the conditions do not actually reverse the apparent strength and the samples have the same distribution of properties, the values are more significantly compared by considering their order, thus comparing the weakest under the several tests, the strongest, and the values which lie at the middle and the quarters in order of strength, called respectively the median, and the first and third quartiles. This is the nearest that can be done to actually testing the same hair under different conditions.

By this method of expression, it becomes possible to pursue this relation to much slower breaks, namely, by hanging small weights on a number of hairs and noting the time of survival. It is then a very probable assumption that the hairs will break in the same order as if tested slowly under steadily increasing load. The hairs were mounted on paper grips and suspended by thin strips of rubber (to absorb vibrations) from a wooden beam resting on rubber pads in the humidified box, which will be described in another paper. They were thus kept at constant temperature (20° C.) and humidity (66% R.H.), protected from vibrations and draughts. A weight of 2·13 gms. was then carefully suspended from each hair and the time at mounting noted.

The following table gives the times within which the hairs broke, the number of new breaks being noted at each examination—

Table II.

Time (hours)	0	½	1	17	18	120	128	171	208	238	256
No. broken	3	3	1	5	2	1	3	1	2	1	2
Time (hours)	333	480	544	574	621	710	728	883	945	960	1128
No. broken	1	1	1	1	1	1	1	2	1	2	1

At 1680 hours, 25 unbroken.

The effect of speed on the apparent strength of weak, medium, and strong hairs can now be followed by plotting the breaking load and time of break (or its logarithm) for the corresponding elements of all the frequency curves. Under steadily increasing load, the time is given by dividing the breaking load by the rate of loading. Under a constant load the conditions are rather different and a fairer comparison is obtained if the period of survival be doubled to give the time of break, for then the maximum final load and the average load over the time are the same as if the tension had been slowly increased from zero. As the time varies a million-fold over the whole range, it is immaterial if the best factor for comparison differs somewhat from 2.

Table III.

Variation of Breaking Load of Hairs of Different Strength.

Rate of Loading	First Break		First Quartile		Median		Third Quartile		Last Break	
Under 2·13 grms. ...	Instant		122 hours		720 hours		> 1680 hours		(?)	
	F	log T	F	log T	F	log T	F	log T	F	log T
Constant load ...	*2·13*	—	2·13	5·944	2·13	6·717	**2·13*	*7·642?*	*2·13*	(?)
Gm./sec.										
0·0029	0·87	2·478	2·74	2·975	4·16	3·157	5·36	3·267	8·73	3·479
0·098	0·89	0·958	3·08	1·497	4·40	1·652	6·35	1·812	9·92	2·005
0·324	0·80	0·393	3·35	1·014	4·85	1·175	6·76	1·319	10·3	1·504
0·665	0·93	0·146	3·86	0·764	5·66	0·930	7·14	1·031	10·8	1·209
0·986	0·72	$\bar{1}$·863	3·74	0·419	5·30	0·730	7·21	0·864	11·7	1·075
1·43	1·0	$\bar{1}$·845	3·63	0·405	5·33	0·571	7·17	0·700	12·9	0·955
2·46	0·8	$\bar{1}$·512	3·61	0·167	5·38	0·340	7·30	0·472	12·2	0·696
3·57	1·0	$\bar{1}$·447	3·70	$\bar{1}$·983	5·38	0·178	†*6·79*	*0·279*	11·8	0·520
Means ...	0·89	0·330	3·32	1·463	4·73	1·717	6·76	1·352	11·04	1·430
$\frac{-dF}{d \log T}$	0·011		0·285		0·515		0·730		1·13	

† This point deviates from the best straight line by much more than three times the probable deviation of the other points, a sampling irregularity only. It is therefore ignored in calculating the best straight line.

*Similar results on yarns show that log T under constant load is almost normally distributed. This figure is given by assuming the two quartiles equally distant from the median. It is not used in calculating the line, but the latter passes almost exactly through it.

The results given in Table III. are plotted in Fig. 4. There is no definite or consistent evidence of curvature in the relation between F and log T, and this is well expressed by a straight line through the points, the deviations from this being random and not excessive as sampling differences. The same applies to the results on the other cottons when plotted against log T.

It would be expected, if the weak and strong hairs were similar save for area of cross-section, that the lines for the different quartiles would converge to a point on the zero of breaking load, *i.e.* the change in strength

be proportional to the strength. There is, however, no apparent time effect on the weakest hairs and the sets of points appear rather to converge at a positive value of the strength. To obtain the best general expression, the straight lines were drawn by the method of least squares* and are given

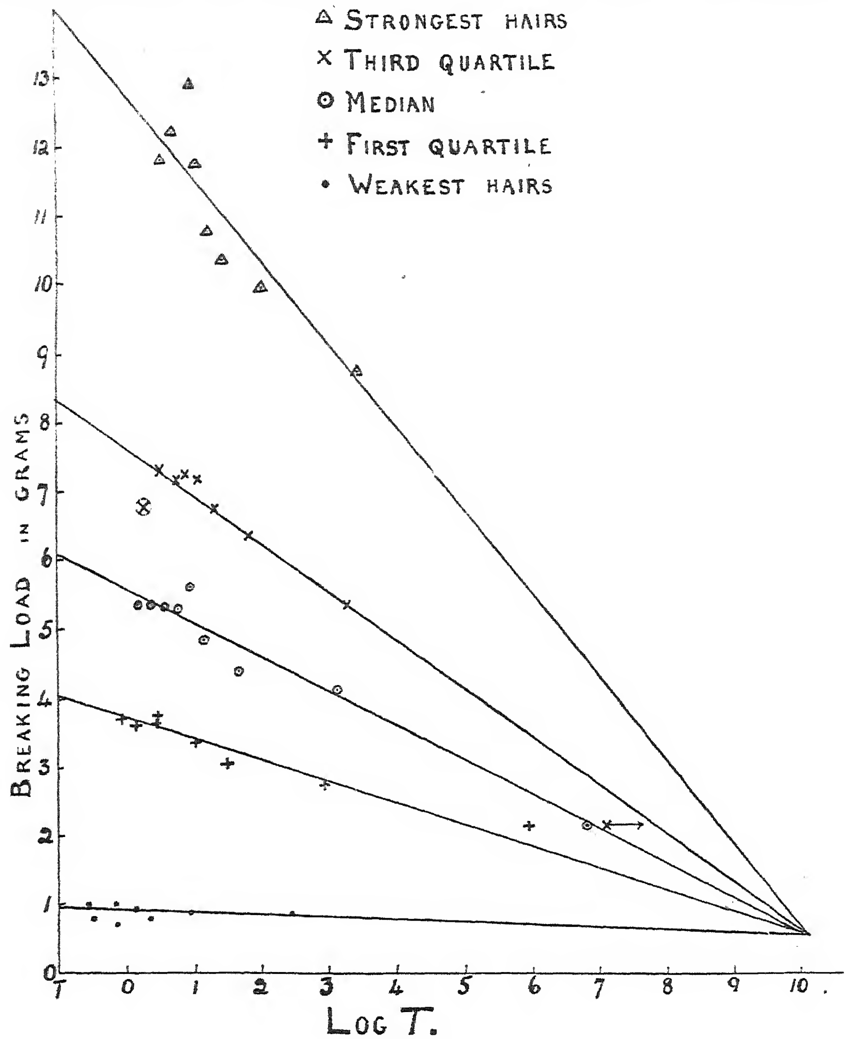


FIG. 4

by the lowest two lines of Table III. The points of convergence were found analytically and the centre of the ten was (F=0·58±0·16, log T=10·1). Of the ten points of convergence, two only were at negative values of F and these were given by the steepest lines; five lie between 0·7 and 0·8 gram and eight above 0·5 gram.

*As the rate of loading is measured with an error negligible compared with that of the determination of F, the condition for the best straight line is that $(\Delta F)^2+(\Delta \log F)^2$ or $(\Delta F)^2\left\{1+\left(\frac{\Delta \log F}{\Delta F}\right)^2\right\}$ be a minimum. The expression in brackets is so near unity and varies so little that this is indistinguishable from the condition that $(\Delta F)^2$ should be a minimum.

On Fig. 4 the points are shown fitted by a pencil of lines through the mean point of convergence and these give a fit scarcely less exact than the lines drawn through each set of points independently. The equation of the pencil is—

$$F - 0{\cdot}58 = 0{\cdot}11\, F_1\, (10{\cdot}1 - \log T).$$

where F_1 is the strength when $\log T$ is unity, *i.e.* for a time of break of 10 seconds.

The question whether the point of convergence is at a positive value of strength is of some physical interest. The value is too small to affect appreciably the large standard deviations and the most sensitive test is to see whether the weakest hairs are affected less in proportion than the strongest. As the single values are liable to considerable variation, the best straight lines were drawn through the mean values of the weakest ten and the strongest ten hairs. These meet at the value +0·818 gram and the effect is most probably real.

The results given on Table I. (A–D) were also plotted against $\log T$ and fitted with the least square line, with the following results—

Table IV.

Logarithmic Relation for Mean Breaking Loads.

Cotton	Mean F	Mean $\log T$	Slope $-dF/d\log T$
Sakel	5·14 ...	1·10 ...	0·504=0·097 F_1
Merc. Sea Island ...	7·92 ...	1·76 ...	1·110=0·127 F_1
Peruvian	8·57 ...	1·09 ...	0·861=0·100 F_1
Durango	5·0 ...	0·76 ...	0·945=0·197 F_1

Of these the last two are not so exactly defined by range of speeds as the first. For practical interpolation and for comparing results at different speeds, the following formula may be used—

$$F = F_1\, (1{\cdot}1 - 0{\cdot}1 \log T).$$

The Physical Nature of the Effect

The study of elastic imperfection goes back into the early part of last century and a great deal of work and of controversy have centered round its many forms. While avoiding the more controversial aspects, it is possible to relate this effect on breaking load with other effects of a simpler nature.

Strains—that is changes of shape and dimensions under stress, in particular extensions—may be divided into three classes, more or less definitely distinguishable. (1) *Elastic strains.* These are proportional to the stress, independent of time or past history, and disappear with the stress. Small strains in crystals and metals are elastic. (2) *"Epibolic" strains.* These produce the phenomena called "elastic after-effect." The strain increases with time but at a decreasing rate, attaining a final equilibrium, and eventually disappears, or decreases gradually to a small value, after removal of stress. These are involved in the stretching of wool fibres[7] and in the time decrease of couple in threads under moderate twist.[6] (3) *Ductile strains.* Semi-viscous flow proceeding indefinitely with time; irreversible, leading to attenuation and rupture.

The relative importance of the three types varies with the nature of the material, the intensity of the stress and its duration. At one limit, a perfectly brittle body will break under a purely elastic strain without any time effect on the breaking stress, at the other a semi-viscous material like pitch will eventually break under its own weight. In a material such as cotton, where the three types are appreciable, the proportion of each in a given

strain depends on the rate at which the strain has been produced and its duration.

The discussion is simplified if the breaking strain be regarded as constant, independent of time effect. A slight variation—and it is certainly much less than that of breaking load—would not affect the following argument and none could be found in yarns. The greatest stress which might be produced by the breaking strain would be found when this was applied so rapidly that no time effects could occur and would correspond to purely elastic strain.

On the other hand, a lower limit to the breaking load is set by the loads which cause only elastic and epibolic strains, when the hair undergoes an immediate extension followed by an increase at an ever lessening rate till a final equilibrium is attained. Collins[2] shows that an equilibrium is thus attained under appreciable loads, 0·5 gram, even on hairs under water.

It is thus clear that the logarithmic law cannot have any significance beyond an approximate description of the effect over the range capable of experimental study. Alternative expressions are capable of reproducing the two limits demanded by physical considerations and imitating the intermediate range perhaps more exactly, but the observations have not that degree of accuracy which would justify discriminating in favour of a more complicated formula.

Other forms of elastic imperfection can be measured more accurately, that closest to the present subject being the decrease in tension at constant extension. The variation of breaking load may be regarded as the decrease of tension with time in a hair stretched to just below the breaking point and held at constant length. The history is somewhat different, but this difference is the same for all rates of loading and should not alter the form of the curve greatly.

Trouton and Rankine[5] have found the load-time relation which keeps a lead wire at constant extension, and express it as—

$$F=c-a\log(T+b)$$

where F is the load at time T, c, a, and b are constants. This is precisely the relation used above to describe the breaking load effect.

The decrease of stress at constant strain can be measured still more accurately under twist, another form of the same physical effect. It has already been found[6] that the couple (C) in twisted cotton hairs is given by an expression—

$$C=c+ae^{-\beta T^{\frac{1}{3}}}$$

This expresses the physical fact of upper and lower limits, which exist in all three forms of the effect, and the data given by Trouton and Rankine have been fitted very accurately by this formula, but it is less elastic than the logarithmic expression and is accurate only for moderate or "epibolic" strains. The general similarity of the curves illustrates the unity of the effect and the behaviour under lower strains provides more accurate data for theories on the nature of elastic imperfection which, as a simple fact, can be regarded as the explanation of this variation of breaking load with rate of loading.

The relations of Fig. 4 indicate that in a batch of cotton of similar origin the strong hairs are more affected than the weak ones. Such a converging pencil would be given by a batch of similar tubes of very thin elastic material

coated internally to varying thicknesses with a stiff plastic substance. It is generally known that thin filaments are proportionally stronger and more elastic than thick ones, the surface layer than internal layers. The figure thus finds a natural explanation if the strength of the cotton hair be regarded as due to two elements, an outer layer relatively more elastic and constant with a varying amount of internal thickening of more imperfect tensile elasticity.

The greater effect on the mercerised Sea Island hairs may be due to a weakening of the outer layer. As the other two varieties were not tested below 0·10 gram per second, their slopes are not sufficiently well defined to correlate with other characteristics.

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10—A NEW METHOD FOR THE ESTIMATION OF ALKALI WITH SPECIAL APPLICATION TO WOOL

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SUMMARY

It is shown that the accurate estimation of total alkali in wool, which is of great importance for research purposes and for the investigation of faults, is not possible with any of the existing analytical methods.

A new method has been devised, depending essentially on the fact that wool placed in water containing terephthalic acid in suspension yields up the whole of the alkali contained in it into solution as sodium terephthalate. This solution can then be estimated by either gravimetric or volumetric methods, which are described in detail.

Using this method it is shown that a measured quantity of alkali, whether as caustic soda, sodium carbonate, or soap, added to wool, can be quantitatively recovered. A convenient and accurate method is thus available for the estimation of the total alkali in wool.

Thus by this method in conjunction with that for estimating soap already published (*J. Text. Inst.*, 1922, **13**, 143), the amounts of alkali present as soap and sorbed alkali respectively can be conveniently and accurately ascertained.

INTRODUCTION

We have previously shown in private reports (Nos. 16, 22, 23, 24, and 25) the importance of estimating the amount of alkali present in wool and fabrics, and have dealt with certain injurious effects which may arise if the amount is not controlled or is unequally distributed. In order to obtain more complete information, not only of the amount of alkali, but also the form in which it is present, we have had to devise more reliable methods of analysis than those previously available. A previous paper (Hirst, *J Text. Inst.*, 1922, **13**, 143) describes a method for the estimation of soap on wool, but the method described below goes further and gives a determination of the total alkali present. Thus the two methods give a closer insight into the mode of distribution of alkali in wool.

The method is suitable for wider application in analysis.

THE DIFFICULTY OF REMOVING ALKALI FROM WOOL

The estimation of alkali, and also of acid, in wool is by no means simple, on account of the special properties of wool itself, which as is well known readily absorbs these reagents. Consequently ordinary methods of titration carried out in presence of the wool are very laborious and uncertain. Again, alkali is held so tenaciously by the wool that simple washing with water never completely removes it. It is certainly not practicable to obtain neutral* wool by this method.

*We use the term "neutral wool" to indicate absence of foreign acid or alkali, and not as a statement that wool entirely freed from such is in itself strictly neutral in chemical character. The conception of the "isoelectric point" of proteins, in general, due to Hardy (*Proc. Roy. Soc.*, 1900, **66**, 110), as the point of maximum instability (or most rapid coagulation) of the colloid hydrosol, has been shown by Loeb ("Proteins and the Theory of Chemical Behaviour," 1922) to be of fundamental importance in relation to a number of specific properties of gelatin. There are many respects in which wool resembles gelatin, and it can be reasonably assumed that there is a definite iso-electric point for wool, as is the case with gelatin. Loeb's researches have shown that with pure gelatin the acid side of its amphoteric character slightly predominates, its *p*H value being 4·7, and that at this (iso-electric) point, the gelatin shows a minimum value for osmotic pressure, specific conductivity, viscosity and, notably, swelling. The iso-electric point of wool substance, which according to Speakman (*J. Soc. Dyers and Col.*, 1925, **41**, 176) is in the neighbourhood of 4·8, is thus of much practical as well as scientific interest.

Investigators working on the sorption of acids and dyestuffs by wool have employed various methods for purifying the wool. In our experience the best method for obtaining wool closely approximating to a strictly neutral condition is to acidise with hydrochloric acid, remove soap acids and other fatty impurities by alcohol-ether extractions, make slightly alkaline with aqueous ammonia, rinse well in distilled water, and dry by gentle heat or in vacuo over sulphuric acid.

The ordinary analytical methods remove soap and fatty acid, and a portion of the alkali present in scoured wool, but there always remains some alkali which is not removed from the wool. This incompleteness of extraction is well illustrated by the two examples below.

(1) *Addition of Caustic Soda to Wool*—A sample of approximately neutral cloth weighing 14·85 grams was treated with 9·2 cc. $N/10$ caustic soda solution diluted with absolute alcohol in sufficient quantity just to wet the cloth. The material was dried in vacuo and then extracted in a soxhlet apparatus with alcohol. Titration of the alkali contained in the alcohol extract gave only 5% of the alkali originally added. Washing four times in hot water and six times in cold, extracted in all a further 48·4%, giving a total of 53·4% recovered.

(2) *Addition of Soap to Wool*—A sample of cloth was impregnated with neutral soap solution (prepared from Kahlbaum's pure oleic acid and the exact equivalent of caustic soda) in quantity just sufficient to be soaked up and equal to 1·14% of soap on the weight of wool. The sample was divided and analysed in two ways—

(*a*) Alcohol extraction followed by repeated water extraction.

	Alkali equivalent to sodium oleate	Fatty acid equivalent to sodium oleate
% Removed by alcohol ...	42·8	99·5
,, water	46·2	0·0
Total	89·0	99·5

(*b*) Repeated water extraction followed by alcohol extraction.

	Alkali equivalent to sodium oleate	Fatty acid equivalent to sodium oleate
% Removed by water	69·0	36·9
,, alcohol ...	16·0	55·6
Total	85·0	92·5

These analyses provide further evidence of the fact that soap left on wool after scouring is present partly as acid soap and partly as alkali sorbed by the wool, and are in accordance with those previously obtained (*loc. cit.*) and with the general conclusions on sorption of soap (see King, *J. Text. Inst.*, 1922, **13**, 127). It will be observed that method (*a*) is the more accurate procedure for obtaining the fatty acid portion, but that neither is efficient as regards the alkali estimation.

Alkali by Titration—Regarding (*a*), a more complete return of the residual alkali is obtained after alcohol extraction by warming the wool in neutral distilled water, and titrating with standard acid in presence of a suitable indicator, such as Phenol Red or phenolphthalein. The titration is continued cautiously with constant stirring and warming from time to time until the indicator shows a permanent change.

This method of titration is interesting in itself, addition of acid to a point of apparent neutrality being followed by a discharge of alkali from the wool

so that the liquor again becomes alkaline. This gradually becomes slower and less marked until the point of actual neutrality is reached. The alkali sorbed by the wool is thus only slowly removed even in presence of very dilute acid solutions.

BEHAVIOUR OF INDICATORS IN TITRATIONS IN PRESENCE OF WOOL

The above described method gives reasonably good results where soap has been previously removed by alcohol extraction, and only sorbed alkali is present in the wool, but it is extremely slow and the final removal of the alkali is always somewhat in doubt.

Further, if soap is present erroneous results are obtained. With indicators whose range is on the alkaline side of neutrality, such as Phenol Red and phenolphthalein, the change point appears while acid soap is still present undecomposed, both acid soap and free fatty acid giving an acid reaction towards these indicators. Thus for a given amount of total alkali in the wool the value obtained will vary with the amount of fatty acid present, and will be somewhat higher than the sorbed alkali but lower than the total alkali present. Also the sensitiveness of such indicators to carbon dioxide in the air not only makes the end-point itself difficult to ascertain, but alters the value of the alkali content found, according to the extent to which it has been carbonated by exposure. Boiling out the carbon dioxide adds to the uncertainty of the result owing to risk of forming reactive products from the wool itself.

On the other hand, the use of indicators not sensitive to carbon dioxide whose change points are on the acid side of neutrality, is quite impracticable in the presence of wool, even if only alkali in caustic form is present. Even with Brom Cresol Purple (*p*H 5·2–6·8) considerable excess of acid has to be added before the indicator becomes permanently changed. The indicator registers the acidity of the solution in equilibrium with wool, and as wool absorbs practically all the acid from dilute solution, much additional acid beyond that required for neutralisation must be added before the residual solution reaches a *p*H value acid enough to affect the indicator.

QUANTITATIVE REMOVAL OF TOTAL ALKALI

There is room therefore for a method which will remove quantitatively and reasonably quickly the total alkali present, and a number of experiments have been made with this end in view.

(1) Attempted Removal as Ammonia

Experiments were made to ascertain if the alkali in the wool would give a quantitative yield of ammonia on boiling the wool in water containing a slight excess of ammonium salt.

Blank experiments showed that alkali in similarly dilute solution, whether as caustic soda, carbonate, or as soap, gave a quantitative yield, but when the experiments were repeated in contact with wool, other volatile alkaline products from the decomposition of the wool itself accompanied the ammonia formed in the main reaction. The extent to which these secondary effects occurred was much less when the distillation was carried out at 40° C. under diminished pressure, but the results were uncertain. Various amides were tried in place of ammonium salts, also with unsatisfactory results, and the method was abandoned.

(2) Removal as Sodium Terephthalate

Though acids and alkalis are readily sorbed by wool, with neutral salts the sorption effect, if it occurs at all, is negligibly small. Thus conversion of the alkali to sodium chloride, for example, would allow of its complete removal from the wool with relatively few washings, but the quantitative estimation of sodium salts is inconvenient for routine tests.

Experiments on the estimation of sulphuric acid in wool* showed that quantitative results could be obtained by conversion into sulphate by means of a carbonate in suspension, *e.g.*, magnesium carbonate and estimation as barium sulphate.

The same principles can be employed for estimating alkali by using a sparingly soluble acid which forms a soluble sodium salt. Acids suitable for this purpose must be solid, easily filterable, and practically insoluble in water, and give alkali salts which are readily soluble in and not appreciably hydrolysed by water. These considerations rule out a large number of acids, including the higher fatty acids. Lauric acid, for example, meets all but the last, but its sodium salt is hydrolysed by water and exhibits the characteristic behaviour of soaps in general of giving up alkali to the wool, with deposition of acid soap on the fibre.

After numerous trials a material suitable from every experimental standpoint was found in terephthalic acid. Chemically, this acid is distinctly stronger than the soap acids and readily decomposes soap, yet its solubility is very slight, its saturated aqueous solution being, in fact, alkaline to Brom Phenol Blue and Methyl Orange, though acid to all indicators whose change points are at pH values greater than 4·5. At 20° C. 1 litre of water dissolves 0·0168 gr. of terephthalic acid, less than 2/1000%. On the other hand, its sodium salt is readily soluble in water, and unlike soap solution, is not decomposed by carbon dioxide. Prepared by adding the acid with shaking to caustic soda until a small permanent excess remains, and then filtering, the solution is just acid (yellowish-green) to Brom Thymol Blue. The principle of the method will be clear from the following equations.

$$2NaOH + C_6H_4(COOH)_2 = 2H_2O + C_6H_4(COONa)_2 \quad . \; . \; . \; A$$

(Caustic soda+terephthalic acid=water+sodium terephthalate.)

$$Na_2CO_3 + C_6H_4(COOH)_2 = 2H_2O + CO_2 + C_6H_4(COONa)_2 \quad . \; . \; B$$

(Carbonate of soda+terephthalic acid=water+carbon dioxide+sodium terephthalate.)

$$2(C_{17}H_{34}COONa) + C_6H_4(COOH)_2 = 2(C_{17}H_{34}COOH) + C_6H_4(COONa)_2 \quad . \; . \; C$$

(Soda soap+terephthalic acid=fatty acid+sodium terephthalate.)

The whole of the combined alkali is thus converted into the equivalent quantity of sodium terephthalate. This can be conveniently rinsed off without handling with the fingers, in a Buchner funnel, or for larger samples by means of a small meat press, adapted to the purpose by being lined with vitralite and fitted with perforated discs of hardite.

Gravimetric Estimation of Alkali

The weight of terephthalic acid obtained by decomposing the filtered liquid with dilute acid is always found to be somewhat greater than corresponds to the quantity of acid which should theoretically be dissolved by the alkali present, and the results are always too high. This is presumably due

*See contribution on "The Estimation of Acid" (following item).

to the formation of a small quantity of acid sodium terephthalate, in addition to the main product, di-sodium terephthalate, represented in the equation above.

Example—10 grams of carefully neutralised wool were treated with standard caustic soda equal to 50 cc. $N/10$ NaOH in 250 cc. of water. After standing an hour, about 1 gram of purified terephthalic acid was added, and the beaker and contents maintained at 50° for two hours with occasional stirring. The wool was well pressed* and rinsed, the united liquors amounting to about 600 cc. filtered from excess of terephthalic acid, and the filtrate precipitated with dilute sulphuric acid. The weight of the dried precipitate of terephthalic acid was 0·4718 gram, compared with 0·4150 gram theoretically obtainable from equation A, or 0·226% NaOH on the weight of the cloth compared with 0·20% actually added.

This method is reasonably good for use in special cases of dyed material which, owing to bleeding of colour, cannot be otherwise estimated, but for general use the more accurate volumetric method described below is to be preferred.

Volumetric Estimation

Terephthalic acid is conveniently adapted to volumetric estimations by using an indicator whose change point occurs at an acid concentration just above that of saturated terephthalic acid solution.

Brom Phenol Blue is admirably suited to this purpose. With a *p*H range of 3·0–4·6 (from yellow to bluish-purple) it gives a neutral grey tint at about *p*H 3·6. When daylight is not available, a "daylight lamp" is preferably used for matching. Methyl Orange has a similar range (*p*H 3·1–4·4), but the colour change is far less striking. On adding acid (previously standardised against alkali using Brom Phenol Blue as indicator) to a liquid containing terephthalic acid and sodium terephthalate, the indicator remains purple until the whole of the sodium terephthalate is converted to acid, when further addition of acid changes the indicator. Thus a measure of the terephthalic acid present as sodium salt, and hence of the alkali removed from the wool, is obtained. The treatment of the wool with terephthalic acid, followed by filtration and washing, is as previously described.

In practice we prefer to add to the liquors a known excess of standard acid and filter, and then titrate back with caustic soda, as the change point of the indicator is somewhat obscured by terephthalic acid in suspension. Alternatively, phenolphthalein or Phenol Red can be used for the back titration, subtracting from the alkali titre the volume equivalent to the small quantity of terephthalic acid dissolved in the filtrate. This is approximately 0·1 cc. $N/10$ NaOH per 100 cc. of filtrate. Standardising against Brom Phenol Blue is thereby obviated, but to avoid a large error it is essential to use an aliquot portion of the original liquor, and to keep the volume of the filtrate small.

It will be observed that *neither the excess of terephthalic acid added to the wool, nor any sorption of terephthalic acid by the wool which might take place, nor the slight solubility of terephthalic acid, nor any formation of mono sodium salt referred to above* affect the result by this method, the terephthalic acid merely acting as a vehicle, so to speak, for the alkali.

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*For routine work it is simpler and sufficiently accurate to commence with a known volume of liquid and analyse an aliquot portion of the liquor.

On the other hand, sorption by the wool of any hydrolysis-caustic soda from the sodium terephthalate formed, after the manner of soda soaps or sodium salts of weak acids in general, would of course vitiate the result. Such action was unlikely in view of the neutral character of the sodium salt, but the point was carefully tested experimentally by leaving sodium terephthalate in contact with neutral wool immersed in water and recovering it in quantitative amount. Examples—

(A) *Sample of Purified Wool*—9·95 grams of the wool, with 0·4 gram of terephthalic acid and 200 cc. of water, were warmed in a beaker to 60°, and then allowed to stand four hours. Sulphuric acid equal to 50·78 cc. $N/10$ was then added to the separated liquors. The filtered solution required 49·62 cc. $N/10$ NaOH. Thus the alkali present in the cloth corresponds to 1·16 cc. $N/10$ NaOH, or 0·046% NaOH calculated on the weight of cloth.

(B) *Above Sample again Treated as before*—The titration difference in this case was 0·15 cc., equal to 0·006% NaOH on the cloth, from which the cloth may be considered neutral within the range of experimental error.

(C) *Alkali in a Scoured Worsted well Washed Off*—Two samples of 10 grams each were treated, one at ordinary temperature with 24 hours' standing, which gave 0·182% caustic soda on the cloth; the other at 60° C. for two hours, which gave 0·211%. This material was used in the experiments detailed below, the average value 0·196 being taken as the alkali content.

(D) *Addition of Caustic Soda*—10·02 grams of cloth were wetted out in 200 cc. of water, to which was added 24·6 cc. $N/10$ caustic soda. After standing some hours, 0·4 gram terephthalic acid was added, the temperature raised to 60°, and the beaker left to stand two hours. The volume of H_2SO_4 added to the separated liquors was 50·78 cc. $N/10$. The filtered solution required 21·60 $N/10$ NaOH. The excess of acid over total alkali added is thus 4·58 cc., which is equal to 0·182% NaOH, compared with 0·196% found in Ex. (C) as being originally present.

(E) *Addition of Sodium Carbonate*—10·07 grams of wool were allowed to stand with 25 cc. $N/10$ Na_2CO_3 in about 200 cc. water. Terephthalic acid (0·4 gram) was then added, and the beaker and contents left to stand overnight. The volume of sulphuric acid added was 50·78 cc. and the caustic soda required was 20·91 cc. $N/10$. Thus the excess acid over the total alkali added is 4·87 cc., showing 0·193% alkali originally present, compared with 0·196 in Ex. (C).

(F) *Addition of Soap Solution*—A 10·05 grams sample was soaked in a warm soap solution equal to 0·979% NaOH on the weight of cloth, followed by addition of terephthalic acid. $N/10$ sulphuric acid added, 50·78 cc. $N/10$ caustic soda required, 21·87 cc. The difference of 28·91 cc. is equal to 1·150% total caustic soda on the cloth. Subtracting 0·196% found in Ex. (C) gives 0·954% soap as caustic soda, compared with 0·979% actually added.

Thus the terephthalic acid method gives quantitative returns of the total alkali in wool, whether present as caustic soda, sodium carbonate, or soap.

CALCIUM SOAPS

The effect of calcium salts, such as calcium oleate and stearate, which might be present on wool, on the method of estimation of alkali was then investigated. An estimation of the solubility of precipitated calcium terephthalate gave 0.484 gram per litre of distilled water at 60° C., from which one may reasonably expect terephthalic acid to be capable of reacting

with calcium soaps. A 10 grams pattern of worsted cloth, as used in the previous experiments, was treated with a mixture of 24·04 cc. $N/10$ caustic soda (=0·962% NaOH on the wool) and 2 grams pure oleic acid. After warming and stirring, 25 cc. $N/10$ calcium chloride solution, sufficient to convert the whole of the soap into calcium soap, was added and allowed to stand for two hours. Then the alkali was estimated by terephthalic acid and the following analytical figures obtained—

Acid added, 48·24 cc. $N/10$.

Back titration required, 19·17 cc. $N/10$ NaOH.

The difference of 29·07 cc. is equivalent to—

Total alkali=1·163% NaOH.

Subtracting 0·196% NaOH originally on the cloth, this leaves 0·967% NaOH for the alkali added, compared with 0·962% actually employed.

Thus calcium soaps are included in this method of estimating total alkali. When these are present a separate estimation of the calcium is necessary.

Miss M. I. Hind has assisted in the estimations. We are also indebted to Mr. J. Barritt, B.Sc. for carrying out independent analyses to check the methods.

11—THE ESTIMATION OF SULPHURIC ACID IN WOOL

By H. R. Hirst and A. T. King

SUMMARY

Work on the effects of sulphuric and other acids on wool, from both the technical and pure research points of view, has hitherto been hampered by want of a method at once accurate and convenient, of determining the actual quantity of acid present in the wool.

This paper describes a novel method, which depends essentially on the observation that sodium terephthalate reacts quantitatively with sulphuric acid present in wool. The method is free from the various objections which are raised against the present methods.

INTRODUCTION

The amount of acid remaining in wool and fabric after commercial treatments, such as dyeing, carbonising, and stoving, is of importance both for research purposes and for the investigation of faults. For example, the acid retained by wool has a considerable effect on dyeing and, after dyeing, has an influence on its power to absorb moisture (British Research Association Report, No. 33), and is also obviously of practical influence in connection with apparent losses in weight after dyeing. Up to the present, however, there has been no reliable method of estimation available.

The usual method is to add to the wool a known volume of, say, $N/10$ ammonia, leave in a stoppered bottle, and pipette off a known volume, which is then titrated for the remaining ammonia. It has been recorded, however (Lloyd, *J. Soc. Dyers and Col.*, 1914, xxx., 12), that "sliver treated with very dilute ammonia slowly absorbs the alkali, this reaction taking place more quickly when warm," on account of which this "generally accepted method for estimating acid in wool and unions is unreliable."

There are no particulars in the literature as to the extent of sorption of ammonia by wool, and this subject is at present under an investigation which is not yet completed. It may, however, be stated here that ammonia is absorbed from $N/10$ solutions to the extent of about 0·25% on the weight of wool, which is equivalent to an error of 0·7% in the estimation of sulphuric acid, apart from irregular results to be expected from such a method.

Regarding the addition of a known excess of alkalis other than ammonia, *e.g.* caustic soda or carbonate of soda, which are absorbed by wool to a greater extent than is ammonia, still larger errors would of course result.

The ammonia method can be made reasonably accurate for technical purposes by introducing a correction factor to allow for the ammonia sorption, or by carrying out a blank on neutral wool, but not sufficiently so for research purposes, especially as varying results would in any case be obtained with varying quantities of soap acid on the fabric.

OTHER PUBLISHED METHODS

The equilibrium between wool and sulphuric acid solutions has been utilised (Woodmansey, *J. Soc. Dyers and Col.*, 1918, xxxiv., 172) to determine the amount of sulphuric acid in wool by steeping the sample in water and then estimating the strength of the solution. The percentage of acid in the wool can then be read off from a curve. This method, apart from its indirect character, takes no account of differences in the sorptive power for acids of wools of different origin, and wools which have been differently processed.

Woodmansey (*loc. cit.*) mentions boiling the cloth with a crystal of Iceland spar, weighed before and after the experiment, but without a satisfactory analytical result.

FAILURE OF TITRATION METHODS GENERALLY

Complete extraction of the acid from the wool by water and titration of the extracts is impracticable. Also the procedure of wetting out the wool in water and running in standard alkali is open to several objections. The titration has to proceed very slowly in the last stages owing to the slow diffusion of the acid from the wool, and the end point is always uncertain for reasons already discussed in detail in the foregoing paper, *i.e.*, that with indicators whose range is on the acid side of neutrality, titration is impossible, and with other indicators, presence of soap acids affects the result.

REMOVAL AS NEUTRAL SALT

Obviously the considerations regarding the relative ease of removal in the form of a neutral salt, with reference to removal of alkali, apply equally to the removal of sulphuric acid. We have obtained fairly satisfactory results gravimetrically by agitating the wool with precipitated calcium or magnesium carbonate, and estimating the soluble sulphate formed by filtering and precipitating as barium sulphate in the usual way. Hydrochloric acid in wool can be similarly estimated as silver chloride. The following is an example, using magnesium carbonate—

A 10 gram sample of wool was placed in distilled water containing 0·1197 gram H_2SO_4, heated to 60° C., and allowed to remain for 15 minutes; 1 gram of $MgCO_3$ was then added, and after standing overnight the sulphuric acid was estimated in the liquor and washings from the cloth by means of barium chloride. The amount of barium sulphate was equivalent to 0·1205 gram sulphuric acid. Another example gave 0·2410 gram, compared with 0·2396 gram added to the cloth.

Magnesium carbonate is preferable to calcium carbonate, but neither method is ideal. If any calcium sulphate is already on the cloth as a result of calcium soaps being present prior to the dyeing or carbonising, it is included in the analytical result. The magnesium carbonate method also returns any metallic sulphates as sulphuric acid.

TEREPHTHALIC ACID METHOD

We have found the terephthalic acid method of estimating alkali (as described above) to be equally well adapted to the estimation of sulphuric acid. Sulphuric acid is quantitatively removed from wool by contact with sodium terephthalate solution in accordance with the equation—

$$H_2SO_4 + C_6H_4(COONa)_2 = Na_2SO_4 + C_6H_4(COOH)_2.$$

A measured volume of standard sodium terephthalate solution is added to the sample wetted out in water, and the subsequent procedure is exactly as described in the preceding paper for estimating alkali in wool volumetrically. In this method no complications are introduced by the presence of soap acids, as these do not decompose sodium terephthalate. Nor do small quantities of calcium or magnesium sulphate interfere.

Example—10 grams cloth containing 0·21% NaOH was treated with 24·12 cc. $N/10$ H_2SO_4 for one hour. Then 58·24 cc. $N/10$ sodium terephthalate solution was added, and the cloth and liquor heated to 60° C.

and allowed to stand overnight. The solution was poured off, the cloth washed* and pressed several times, the united solutions filtered and then 48·24 cc. $N/10$ H_2SO_4 added, and the solution again filtered and titrated with $N/10$ NaOH, using Brom Phenol Blue as indicator, 7·64 cc. being required.

The alkali originally present in the cloth (0·21%) corresponds to 5·25 cc. $N/10$ caustic soda. Thus the total alkali is 58·24+7·64+5·25=71·13 cc., which after subtracting 48·24 cc. $N/10$ H_2SO_4, subsequently added, leaves 22·89 cc. for that initially added, compared with 24·12 actually used, or 1·12% H_2SO_4 on the cloth, compared with 1·18%. The method has been found in practice to give concordant results.

Equally good results are obtained either by heating the cloth in the sodium terephthalate solution to 60° C. for 15 minutes and allowing to stand for three hours before filtering, or allowing the solution to act cold overnight. With dyed wool or cloth it is often an advantage to perform the estimation cold, so as to avoid colouring the solution and masking the indicator. We find, however, that when estimating acid on material dyed with dyes which are readily stripped, the gravimetric method, using magnesium carbonate, is the more satisfactory.

ESTIMATION OF ACID IN DYEBATH AND IN WOOL AFTER DYEING

A piece of white worsted cloth, weighing 10 grams and containing 0·21% alkali as NaOH, was dyed with 3% Orange GG crystals (Cas.) previously purified, and 46·7 cc. of $N/10$ sulphuric (equal to 2·39% on the weight of the cloth) in 500 cc. water, boiling for one hour. The dyeing operation was carried out in a flask provided with an air condenser. The residual liquor, two wash waters from the cloth, and the cloth after washing were analysed separately by the sodium terephthalate method.

The dyebath gave H_2SO_4 equivalent to ...	4·66 cc.	$N/10$ H_2SO_4
The first wash water from cloth	1·80 cc.	,,
The second wash water from cloth	1·04 cc.	,,
The cloth after twice washing	23·85 cc.	,,
The total acid recovered is thus	31·35 cc.	,,
Which is equivalent to	0·1536 gram	H_2SO_4
The dye (equivalent=226) contains sodium equivalent to	0·065	,,
Alkali originally in cloth corresponds to ...	0·0257	,,
Acid accounted for	0·2443	,,
Compared with acid actually used	0·239	,,

This leaves 0·005 gram H_2SO_4 unaccounted for, which represents a total accumulated error of 2½%.

*For routine tests it is simpler and sufficiently accurate to analyse an aliquot portion of the liquor.

12—COMPARISON OF THE AFFINITY OF COTTON, WOOL, AND PARTICULARLY CELLULOSE ACETATE SILK FOR AZO COMPOUNDS (DYESTUFFS) CONTAINING SULPHONIC, CARBOXYL, ARSINIC, AND STIBINIC ACID GROUPS

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(The Silver Springs Bleaching and Dyeing Co. Ltd.)

General experience and research (cf. R. Clavel, E.P.182,830 and 182,844; British Dyestuffs Corporation Ltd., A. G. Green, and H. K. Saunders, E.P. 200,873; The Silver Springs Bleaching and Dyeing Co. Ltd. and A. J. Hall, E.P.222,001) show that with few exceptions (cf. British Dyestuffs Corporation Ltd. and G. H. Frank, E.P.226,948), cellulose acetate artificial silk has little or no affinity for aromatic compounds containing one or more sulphonic acid groups. Since it is generally desirable to employ water-soluble dyestuffs for cotton, wool, and natural silk, a large proportion of these dyestuffs are prepared from components containing substituted sulphonic acid groups and are therefore unsuitable for the dyeing of cellulose acetate silk.

Almost all those dyestuffs now in use for dyeing cellulose acetate silk are insoluble in water and are employed in aqueous suspensions (cf. J. S. Wilson, *J. Soc. Dyers and Col.*, 1925, **41**, 169) or colloidal solutions (S.R.A. dyestuffs) prepared by means of such substances as Turkey-red oil, oleates, and naphthenates (cf. G. H. Ellis, *J. Soc. Dyers and Col.*, 1924, **40**, 285). The use of these dyestuffs for the production of shades fast to rubbing requires an alkaline dyebath and the presence of free acid precipitates insoluble fatty acids in the form of an objectionable scum.

In the dyeing of mixtures of cotton and cellulose acetate silk with two colours in one bath the use of an alkaline bath presents no difficulty, for although it must be remembered that cellulose acetate is much more readily hydrolysed by alkalis than by acids, most direct cotton dyestuffs have a good affinity for cotton in an alkaline bath. On the other hand, the dyeing of wool usually requires the use of an acid dyebath and this renders difficult the dyeing of mixtures of wool and cellulose acetate silk with two colours in one bath. There is thus a demand for dyestuffs which are easily water-soluble and whose application to cellulose acetate silk does not require the presence of soaps or other solubilising substances in the dyebath.

The affinity of cellulose acetate for aromatic compounds is decreased by the presence of substituted sulphonic acid, carboxyl and hydroxyl groups, the effect of these groups decreasing in the order named. For example, with the exception of a few aromatic azo dyestuffs containing a sulphonic acid group in the ortho position to the azo link (cf. British Dyestuffs Corporation Ltd. and G. H. Frank, E.P.226,948, L. B. Holliday & Co. Ltd., and A Young, E.P. 244,936), no dyestuffs containing sulphonic acid groups are suitable for dyeing cellulose acetate, whereas a number of suitable dyes containing carboxyl (cf. British Dyestuffs Corporation Ltd., J. Baddiley, J. Hill, and E. B. Anderson, E.P.202,157; British Dyestuffs Corporation Ltd., J. Baddiley, and W. W. Tatum, E.P.207,711) and hydroxyl

groups are known. The possibility that dyestuffs soluble in water by reason of the presence of substituted arsinic, $AsO(OH)_2$, or stibinic $SbO(OH)_2$ acid groups may be suitable for dyeing cellulose acetate silk from neutral or acid dyebaths has apparently been overlooked.

Azo compounds containing arsinic acid groups have been described previously (cf. Noelting, *Bull. Soc. Chim.*, 1916, **19**, iv, 361), but it is not believed that they have found application as dyestuffs although many of them could be produced at a reasonable cost.

In the course of other investigations an opportunity occurred for comparing the affinity of cellulose acetate silk (also cotton and wool) for a number of azo compounds containing sulphonic, carboxylic, arsinic, and stibinic acid substituted groups and of further ascertaining the possibility of utilising such organo-arsenic and antimony compounds for dyeing or otherwise treating cellulose acetate silk. The results of these investigations are summarised below.

For the purposes of these investigations the following azo dyestuffs were prepared in the form of sodium salts from their components by the usual processes of diazotisation and coupling.

Compounds containing Sulphonic Acid Groups

Prepared from Sulphanilic Acid.—Sodium salts of α-naphthol-azo-phenyl-4-sulphonic acid (dark purple slender plates; easily soluble in cold and hot water), β-naphthol-azo-phenyl-4-sulphonic acid (golden yellow needles; easily soluble in cold and hot water), phenol-azo-phenyl-4-sulphonic acid (golden yellow plates; easily soluble in cold and hot water), and salicylic acid-azo-phenyl-4-sulphonic acid (yellow powder; easily soluble in cold and hot water).

Compounds containing Carboxyl Acid Groups

Prepared from p-Amino-benzoic Acid.—Sodium salts of α-naphthol-azo-phenyl-4-carboxylic acid (dark red compact cubical crystals; easily soluble in cold and hot water), β-naphthol-azo-phenyl-4-carboxylic acid (red rosettes; easily soluble in cold and hot water), phenol-azo-phenyl-4-carboxylic acid (orange needles; easily soluble in cold and hot water), and salicylic acid-azo-phenyl-4-carboxylic acid (yellow microscopic needles; easily soluble in cold and hot water).

Compounds containing Arsinic Acid Groups

Prepared from p-Arsanilic Acid.—Sodium salts of α-naphthol-azo-phenyl-4-arsinic acid (red microscopic plates; difficultly soluble in cold, easily soluble in hot water), β-naphthol-azo-phenyl-4-arsinic acid (orange slender needles; easily soluble in cold and hot water), phenol-azo-phenyl-4-arsinic acid (orange plates; easily soluble in cold and hot water), and salicylic acid-azo-phenyl-4-arsinic acid (pale brown powder; easily soluble in cold and hot water. Free acid; yellow compact crystals; insoluble in cold and hot water).

Compounds containing Stibinic Acid Groups

Prepared from p-Stibanilic Acid.—Sodium salts of α-naphthol-azo-phenyl-4-stibinic acid (reddish-brown powder; easily soluble in cold and hot water), β-naphthol-azo-phenyl-4-stibinic acid (scarlet rosettes; difficultly soluble in cold and hot water), phenol-azo-phenyl-4-stibinic acid (orange compact needles; difficultly soluble in cold and hot water), and salicylic acid-azo-phenyl-4-stibinic acid (light brown powder; easily soluble in cold and hot water).

Table I.

Azo Dyestuff	Shades of Dyeings on: Wool	Cotton	Cellulose Acetate: *a* (Alkaline)	Cellulose Acetate: *b* (Acid)
α-Naphthol-azo-phenyl-4-sulphonic acid	Deep brown	Stained bluish-pink	Stained pink	—
β-Naphthol-azo-phenyl-4-sulphonic acid	Bright reddish-orange	Stained pink	Pale orange	—
Phenol-azo-phenyl-4-sulphonic acid	Bright yellow	Colourless	Colourless	—
Salicylic acid-azo-phenyl-4-sulphonic acid	Bright yellow	Colourless	Colourless	—
α-Naphthol-azo-phenyl-4-carboxylic acid	Yellowish-brown	Pale pink	Stained yellow	—
β-Naphthol-azo-phenyl-4-carboxylic acid	Bright scarlet	Pale orange	Pale orange	—
Phenol-azo-phenyl-4-carboxylic acid	Yellow	Colourless	Colourless	—
Salicylic acid-azo-phenyl-4-carboxylic acid	Dull yellow	Stained yellow	Colourless	—
α-Naphthol-azo-phenyl-4-arsinic acid	Dull yellowish-brown	Pale yellow	Colourless	Deep reddish-yellow
β-Naphthol-azo-phenyl-4-arsinic acid	Bright orange	Stained orange	Stained orange	Deep orange
Phenol-azo-phenyl-4-arsinic acid	Pale yellow	Colourless	Colourless	Yellow
Salicylic acid-azo-phenyl-4-arsinic acid	Dull yellow	Colourless	Colourless	Greenish-yellow
α-Naphthol-azo-phenyl-4-stibinic acid	Reddish-brown	Pale pink	Pale orange	Stained brown
β-Naphthol-azo-phenyl-4-stibinic acid	Yellowish-orange	Pale orange	Pale orange	Deep orange
Phenol-azo-phenyl-4-stibinic acid	Yellow	Pale yellow	Pale yellow	Stained yellow
Salicylic acid-azo-phenyl-4-stibinic acid	Yellow	Pale yellow	Colourless	Stained yellow

Comparison of the above azo compounds indicates that those containing stibinic acid groups are less soluble in water than the corresponding compounds containing arsinic acid groups.

Samples of cellulose acetate silk (Celanese) yarn, bleached cotton fabric and bleached wool yarn were dyed with 5%, 2%, and 2% shades respectively under the following conditions.

Conditions of Dyeing

Cellulose Acetate Silk Yarn.—(*a*) Alkaline. One gram of yarn was dyed for one hour at 65° to 70° C. in 30 cc. of a 0·2% solution of soap and ammonia, then rinsed thoroughly in warm water and dried.

(*b*) Acid. One gram of yarn was dyed for one hour in 30 cc. of dye liquor initially at 60° C., and containing 15% of Glauber's salt, the temperature being raised to 75° C. and 3% of sulphuric acid added during the first ¼-hour and the dyeing continued at 75° C. The dyed yarn was afterwards thoroughly washed in warm water and dried.

Bleached Cotton Fabric.—One gram of bleached cotton fabric was dyed for one hour in 30 cc. of dye liquor initially at 50° C., the temperature being raised to 90° C. during the first ¼-hour and maintained at 90° C. No assistants were employed. The dyed fabric was afterwards thoroughly rinsed in cold water and dried.

Wool Yarn.—Ten grams of bleached wool yarn were dyed for one hour in 300 cc. of dye liquor initially at 60° C. and containing 15% of Glaubers salt, the temperature being increased to 100° C. (approximately) within the first ¼-hour and maintained at 100° C. Exhaustion of the dye liquor was assisted by the addition of 3% of sulphuric acid within 15 minutes from the commencement of dyeing. The dyed wool was thoroughly washed in cold water and then dried.

Examination of the resulting dyeings yielded the results shown in Table I.

Subsequently, the fastness of the dyeings on cotton, wool, and cellulose acetate silk to boiling water and soap was determined under the following conditions and with the results shown in Table II.

Fastness to Boiling Water.—¼-gram of dyed material was immersed in 30 cc. of water at 99° to 100° C. for one hour, then rinsed in cold water and dried.

Fastness to Soap.—¼-gram of dyed material was immersed in 30 cc. of a 0·2% solution of soap and ammonia at 99° to 100° C. for one hour, then rinsed in cold water and dried.

In the case of cellulose acetate silk both tests for fastness were carried out at 75° C. instead of 100° C.

Fastness to Light.—The dyed materials were exposed for 540½ hours in a standard Fadeometer apparatus. Since six hours' exposure in a Fadeometer are about equal to one bright mid-summer day, the above period of exposure is considered equivalent to three months of bright summer days.

The different results obtained by dyeing cellulose acetate silk in alkaline and acid dyebaths was largely due to the fact that the azo arsenic and antimony compounds were soluble in the former and insoluble in the latter. Cellulose acetate silk treated in the acid dyebaths appeared to be superficially coloured and was readily decolorised by soaping, dyeings with α-naphthol-azo-phenyl-4-arsinic acid and salicylic acid-azo-phenyl-4-arsinic acid being exceptional.

Table II.

Azo Dyestuff		Fastness to Boiling Water	Fastness to Soap	Fastness to Light
α-Naphthol-azo-phenyl-4-sulphonic acid	C	Nearly decolorised	Nearly decolorised	
	W	Unchanged	Much loss of colour	Moderately decolorised
	CA(*a*)	Nearly decolorised	Nearly decolorised	
β-Naphthol-azo-phenyl-4-sulphonic acid	C	Decolorised	Decolorised	
	W	Unchanged	Much loss of colour	Moderately decolorised
	CA(*a*)	Slightly decolorised	Slightly decolorised	
Phenol-azo-phenyl-4-sulphonic acid	C	—	—	
	W	Moderate loss of colour	Decolorised	Moderately decolorised
	CA(*a*)	—	—	
Salicylic acid-azo-phenyl-4-sulphonic acid	C	—	—	
	W	Unchanged	Decolorised	Moderately decolorised
	CA(*a*)	—	—	
α-Naphthol-azo-phenyl-4-carboxylic acid	C	Nearly decolorised	Nearly decolorised	
	W	Slightly decolorised	Moderately decolorised	Moderately decolorised
	CA(*a*)	Nearly decolorised	Nearly decolorised	
β-Naphthol-azo-phenyl-4-carboxylic acid	C	Nearly decolorised	Nearly decolorised	
	W	Slightly decolorised	Much loss of Colour	Moderately decolorised
	CA(*a*)	Slightly decolorised	Slightly decolorised	
Phenol-azo-phenyl-4-carboxylic acid	C	—	—	
	W	Largely decolorised	Decolorised	Moderately decolorised
	CA(*a*)	—	—	
Salicylic acid-azo-phenyl-4-carboxylic acid	C	—	—	
	W	Unchanged	Unchanged	Largely decolorised
	CA(*a*)	—	—	

C=Cotton; W=Wool; CA(*a*)=Cellulose Acetate Silk dyed in Alkaline Bath; CA(*b*)=Cellulose Acetate Silk dyed in Acid Bath.

Table II.—*continued*

Azo Dyestuff		Fastness to: Boiling Water	Fastness to: Soap	Fastness to: Light
α-Naphthol-azo-phenyl-4-arsinic acid	C	—	—	
	W	Slightly decolorised	Much loss of colour	W Nearly decolorised
	CA(a)	Decolorised	(a) Decolorised	
			(b) Changed to golden yellow	
β-Naphthol-azo-phenyl-4-arsinic acid	C	Nearly decolorised	Decolorised	
	W	Unchanged	Slightly decolorised	W Moderately decolorised
	CA(a)	Decolorised	(a) Decolorised	
			(b) Decolorised	
Phenol-azo-phenyl-4-arsinic acid	C	—	—	
	W	Largely decolorised	Largely decolorised	W Moderately decolorised
	CA(a)	—	(a) —	
			(b) Decolorised	
Salicylic acid-azo-phenyl-4-arsinic acid	C	—	—	
	W	Slightly decolorised	(a) Largely decolorised	W Moderately decolorised
	CA(a)	—	—	
			(b) Changed to moderately full yellow	
α-Naphthol-azo-phenyl-4-stibinic acid	C	Unchanged	Nearly decolorised	
	W	Slightly decolorised	Largely decolorised	W Moderately decolorised
	CA(a)	Unchanged	(a) Slightly decolorised	
			(b) Decolorised	
β-Naphthol-azo-phenyl-4-stibinic acid	C	Moderately decolorised	Moderately decolorised	
	W	Slightly decolorised	Largely decolorised	W Nearly decolorised
	CA(a)	Slightly decolorised	(a) Slightly decolorised	
			(b) Decolorised	
Phenol-azo-phenyl-4-stibinic acid	C	Decolorised	Decolorise	
	W	Slightly decolorised	Slightly decolorised	W Nearly decolorised
	CA(a)	Largely decolorised	(a) Nearly decolorised	
			(b) Decolorised	
Salicylic acid-azo-phenyl-4-stibinic acid	C	Largely decolorised	Largely decolorised	
	W	Unchanged	Largely decolorised	W Nearly decolorised
	CA(a)	—	(a) —	
			(b) Decolorised	

C=Cotton; W=Wool; CA(a)=Cellulose Acetate Silk dyed in Alkaline Bath; CA(b)=Cellulose Acetate Silk dyed in Acid Bath.

From these investigations the following conclusions are drawn—

(1) Cellulose acetate silk and cotton have but little, and wool considerable affinity for all the azo compounds described above.

All the dyeings on wool have approximately equally good fastness to boiling water but have little fastness to boiling soap.

Azo compounds containing sulphonic, carboxylic, and arsinic acid groups have approximately equal fastness to light, whereas azo compounds containing stibinic acid groups are considerably less fast.

(2) Azo compounds containing stibinic acid groups have a greater affinity than those corresponding compounds containing arsinic acid groups for cellulose acetate silk, but these differences cannot be correlated to differences in the solubilities of the azo compounds in water.

(3) Azo compounds containing β-naphthol have a greater affinity than compounds containing α-naphthol for cellulose acetate silk (this is supported by results obtained in other, unpublished, investigations).

(4) The differences shown in the affinities of phenol-azo-phenyl-4-stibinic acid and salicylic acid-azo-phenyl-4-stibinic acid agree with the general observation that cellulose acetate silk has a decreasing affinity for azo compounds containing carboxyl and hydroxyl groups.

(5) The affinity of cellulose acetate silk for azo compounds containing sulphonic, arsinic, stibinic, and carboxylic acid groups increases in the order named.

(6) Although none of the organo-azo-arsenic and antimony compounds described above are suitable as dyestuffs for cellulose acetate silk, it appears probable that azo compounds containing arsinic and stibinic acid groups capable of satisfactory application to this textile material could be prepared.

In conclusion, the authors express their thanks to The Silver Springs Bleaching and Dyeing Co. Ltd., Congleton, for facilities afforded in carrying investigations.

13—THE LITERATURE OF KERATIN (THE PRINCIPAL CONSTITUENT OF WOOL)

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INTRODUCTION

In a study of the literature of keratin, one is immediately impressed with the fact that for a satisfactory understanding of the subject a certain general knowledge of the properties and reactions of the proteins is essential. It is because of this fact that much of what follows deals with proteins in a general manner. In the literature it is often found that the term keratin is loosely applied to many of the degradation products of keratin, which is incorrect and misleading. Keratin (see below) is obtained from definite sources and in a definite manner, and as such is clearly defined and restricted. It is to be distinguished from gelatin* and other proteins of the scleroprotein class, to which class it belongs.

Keratin is the principal constituent of the epidermis, hair, nails, hoofs, horns, *wool*, feathers, skins of egg shells, &c. When any of these substances are treated in succession with boiling ether, alcohol, water and dilute acids, or successively with artificial gastric juice, artificial pancreatic juice, boiling alcohol and boiling ether, the insoluble residue retains the shape of the original tissue and is known as *keratin*.

THE ANALYSIS OF KERATIN

The product varies somewhat in character and composition with its origin, so that a number of allied substances are comprehended under the general name of keratin. The following table, quoted from Allen's Organic Analysis, viii., illustrates the composition of the "keratin" obtained from different sources.

*For the sake of clarity some of the distinctions between keratin and gelatin will be given here, and will be understood after reading subsequent subject matter.

Gelatin is negative to the following tests—(i.) Millons. (ii.) Adamkiewicz. (iii.) Xanthoproteic (sometimes faintly positive).

Keratin, on the other hand, gives a positive reaction to all these tests.

Gelatin will mix with water in all proportions, but under ordinary conditions of temperature and pressure this is not true of keratin (*e.g.* wool).

Gelatin contains no tryptophane, cystine, or tyrosine, but contains more glycine than any other protein except elastin. It also contains a large amount of proline and oxyproline.

Keratins are remarkable for containing more cystine than any of the other proteins, human hair containing 14%. Tyrosine is present in fair amount, and the leucine and glutamic acid content is high.

It may be remarked that gelatin and keratin (at least many keratins) are amphoteric and in the case of gelatin the iso-electric point is found to be at $p\mathrm{H}=4{\cdot}7$ (*i.e.* on the acid side).

Source of Keratin	Carbon C	Hydrogen H	Nitrogen N	Sulphur S	Oxygen O_2*	Authority
Feathers ...	52·46	6·94	17·74	?	22·86	—
Quills	51·7	7·2	17·9	—	—	Scherer
Wool	50·65	7·03	17·71	4·61	20·00	,,
Hair (mans) ...	50·65	6·36	17·14	5·00	20·85	Van Laer
Fur (white rabbit)	49·45	6·52	16·81	4·02	23·20	Kühne and Chittenden
Nails	51·00	6·94	17·51	2·80	21·75	Mülder
,, ...	51·09	6·82	16·90	2·80	22·39	Scherer
Horn (cows) ...	51·03	6·80	16·24	3·42	22·51	Tilanus
Hoof (horses) ...	51·41	6·96	17·46	4·23	19·94	Mülder
Epithelium ...	51·53	7·03	16·64	2·18	22·32	Hoppe-Seyler
Epidermis ...	50·28	6·76	17·21	·74	25·01	,,
Whalebone ...	51·86	6·87	15·70	3·60	21·97	Van Kerckoff
Tortoise shell ...	54·89	6·56	16·77	2·22	19·56	Mühle
Neuro-Keratin (brain)	56·99	7·53	13·15	1·87	20·46	Kühne and Chittenden

Bourquelot[1] gives the following limits of composition of keratoids so far as has been recorded at present—

Carbon	50·3 to 52·5%
Hydrogen	6·4 to 7·3%
Nitrogen	16·2 to 17·7%
Oxygen	20·7 to 25·0%
Sulphur	·7 to 5·0%

Among many interesting analyses recorded in the literature, the following, due to Abderhalden and Fuchs,[2] is of particular interest in so far as it shows that from the same animal the constituents in the keratin vary considerably with age.

	Hoof of Ox		Horn of Ox		Hoof of Horse
	1 yr. old	4 yrs. old	1 yr. old	4 yrs. old	
Dry residue	90·5	91·5	96·0	96·5	75·4
Ash	·14	·16	·22	·36	·45
†Melanin substance	·22	·12	1·65	·96	·9
‡Glutamic acid hydrochloride in ash-freed residue	18·0	16·8	13·8	12·9	18·2

From the above two tables one can see that keratin substance is of variable composition. The carbon and hydrogen are fairly constant, but the percentages of sulphur and oxygen vary within comparatively wide limits. It is of interest to note the variation due to varying age of the animal.

The Presence of Elements, other than Carbon, Hydrogen, Nitrogen, Sulphur, and Oxygen, in Keratin

Gautier[3] states that the proteins of the thyroid gland, which contain arsenic and iodine, exert an activating influence on the organisms and promote the renewal of tissues. They are, however, especially attracted by the organs of the ectodermis, the brain, and principally by the skin. The skin utilises these proteins for the growth of the hair and of the epidermis. In male individuals the arsenic and iodine are excreted from the system by

*Oxygen by difference.

†Melanin substance is a brownish-black residue formed on hydrolysis of almost all proteins.

‡Glutamic acid (see list of Hydrolysis Products of Proteins).

the falling out of the hair, the shedding of the horns, and the scaling of the uppermost layer of the skin. In female individuals the elements are excreted in a different form.

In a paper due to G. Bertrand,[4] the above work of Gautier in respect to arsenic is verified, the method involving complete oxidation with nitric acid. It is shown that arsenic is especially to be found in keratin substances.

The presence of arsenic in various wool samples has been studied by Thorpe.[4a] In almost (but not quite) all samples arsenic is found in small amounts. In all samples it was found that the white ends near the body contained less than the tips. The amount of arsenic usually ranged from ·005 to ·037 milligrams of arsenious oxide per gram of wool. It appears probable that arsenic is not an essential constituent of wool, but is easily introduced by arsenical sheep dips or internally (see Gautier above).

It is usually stated in the literature (*cf.* Mathews, Textile Fibres, 1924, p. 124) that in wool a small amount of mineral matter appears to be present as an essential constituent of the fibre itself. It is left as ash when wool is ignited and amounts in some samples to 1% and contains many elements other than carbon, nitrogen, hydrogen, oxygen, and sulphur, *e.g.* potassium, sodium, calcium, aluminium, iron, silicon, and phosphorus. Considering the variation in the amount of ash found, and also in view of the fact that almost all the above mentioned elements are to be found in the suint, it appears reasonable to suggest that many of the above elements are probably not essential constituents of wool keratin.

Buchtala[5] has shown that the keratin of the elephant epidermis contains considerable quantities of iron.

THE CONSTITUTION OF KERATIN

Keratin belongs chemically to that class of substances known as *proteins*, of which some forty or fifty natural ones are known to occur in both animals and plants, and are divided according to their origin, coagulability on heating, and other physical characteristics into a series of groups. This separation into groups is very arbitrary, and no real classification of proteins is possible, due to our insufficient knowledge of their chemical constitution. For a list of these groups reference may be made to any book relating to the subject, *e.g.* Monograph by Plimmer, "Constitution of the Proteins."

Almost all the proteins contain carbon, hydrogen, nitrogen, sulphur, and oxygen, and they possess the following elementary composition—

C	51—55%
H	7%
N	15—19%
S	·4 to 2·5%
O	20—30%

Keratin belongs to the scleroprotein group. This group consists of the following—Keratin (from hair, horn, feathers, egg membrane, &c.), collagen, gelatin, elastin, silk fibroins, and silk gelatin.

As illustrating the complexity* of the molecule, the formula of globin, the basis of hæmoglobin, as obtained from an analysis such as that given above, is given approximately as $C_{730}H_{1170}N_{190}S_3O_{210}$, this representing a lower limit.

*It is known that hæmoglobin contains iron, and analysis leads to the fact that assuming there to be only one atom of iron in the molecule, the molecular weight has a minimum value of about 16,600. This value is in agreement with those obtained from data on the combination of carbon dioxide and oxygen with hæmoglobin.

Investigations on the chemical constitution of the proteins have been carried on now for nearly a century, but it is only in recent years that the work of E. Fischer and his pupils has thrown any real light on their actual constitution. The main result of these investigations is that the protein molecule is built up of a number of amino acids belonging to four different series (see following list).

It is generally assumed that these amino acids are linked together in the protein molecule as in the polypeptides, by the union of the amino group of one molecule with the carboxyl group of another. Thus—

$$NH_2-\underset{}{\overset{R'}{\overset{|}{C}}}H-COOH+NH_2-\overset{R''}{\overset{|}{C}}H-COOH \longrightarrow NH_2-\overset{R'}{\overset{|}{C}}H-CO-NH-\overset{R''}{\overset{|}{C}}H-COOH+H_2O$$

represents the condensation of two amino acids. The formation of a protein may be represented—

$$NH_2-\overset{R'}{\overset{|}{C}}H-COOH+NH_2-\overset{R''}{\overset{|}{C}}H-COOH+\;.\;.\;.\;.\;.\;+NH_2-\overset{R^n}{\overset{|}{C}}H-COOH$$

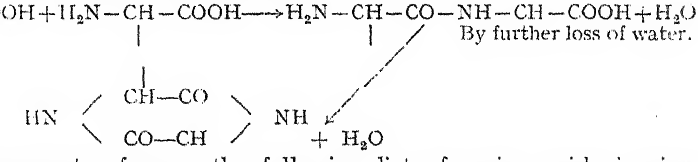
$$=\underbrace{NH_2-\overset{R'}{\overset{|}{C}}H-CONH-\overset{R''}{\overset{|}{C}}H-CO\;.\;.\;.\;.\;CO-NH-\overset{R^n}{\overset{|}{C}}H-COOH}_{\text{Protein Molecule.}}+(n-1)H_2O$$

In this equation R may represent a simple alkyl or aryl group, or a similar group, in which a hydrogen atom is substituted by an amino or a carboxyl group. This fact, coupled with the probable large value of "n," gives some indication of the complexity of the protein molecule.

The possibility of other types of grouping must be considered, and E. Fischer has suggested that piperazine groups may be present in the protein molecule.

Ring formation is easily accounted for by the elimination of water from a complex of two amino acid molecules, as follows—

$$H_2NCH-COOH+H_2N-CH-COOH \longrightarrow H_2N-CH-CO-NH-CH-COOH+H_2O$$



For subsequent reference the following list of amino acids is given. These acids, together with ammonia, are obtained in the hydrolysis of proteins, and most proteins contain all these amino acids or units in various proportions, but some proteins, *e.g.* gelatin, contain only fourteen or fifteen, and a few, such as salmine, are built up of three or four units, these being di-amino acids and histidine.

Fischer has succeeded in synthesising compounds built up of as many as eighteen amino acids, and some of the products obtained have shown properties very similar to many naturally occurring proteins.

It is known that many proteins can be hydrolysed to amino acids by use of various enzymes, and one of the best proofs that proteins are built up of amino acid complexes (*i.e.* polypeptides) is that furnished by Fischer of the action of enzymes upon the synthetical products. It was found that with the exception of pepsin the various enzymes of the body are quite capable of hydrolysing the polypeptides into amino acids.

HYDROLYSIS PRODUCTS OF PROTEINS

(A) Mono-aminocarboxylic Acids

Glycine, or amino acetic acid, $CH_2(NH_2){-}COOH$.

Alanine or α-aminopropionic acid, $CH_3{-}CH(NH_2){-}COOH$.

Valine or α-aminoisovaleric acid, $\begin{array}{l} CH_3\diagdown \\ \quad\; CH{-}CH(NH_2){-}COOH. \\ CH_3\diagup \end{array}$

Leucine or α-aminoisocaproic acid, $\begin{array}{l} CH_3\diagdown \\ \quad\; CH{-}CH_2{-}CH(NH_2){-}COOH. \\ CH_3\diagup \end{array}$

Caprine or α-aminocaproic acid, $CH_3CH_2CH_2CH_2CH(NH_2)COOH$,

Isoleucine or α-amino-β-methyl-β-ethyl propionic acid—

$$\begin{array}{l} CH_3\diagdown \\ \quad\; CH{-}CH(NH_2){-}COOH. \\ C_2H_5\diagup \end{array}$$

Phenylalanine or β-phenyl-α-aminopropionic acid—

$$C_6H_5{-}CH_2{-}CH(NH_2){-}COOH.$$

Tyrosine or β-*p*-hydroxyphenyl-α-aminopropionic acid—

$$(OH){-}C_6H_4{-}CH_2{-}CH(NH_2){-}COOH.$$

Serine or β-hydroxy-α-aminopropionic acid—

$$OH{-}CH_2{-}CH(NH_2){-}COOH.$$

Cystine, dicysteine or di-β-thio-α-aminopropionic acid—

$$HOOC{-}CH(NH_2){-}CH_2S{-}S{-}CH_2{-}CH(NH_2){-}COOH,$$

(B) Mono-aminodicarboxylic Acids

Aspartic acid or aminosuccinic acid, $\begin{array}{l} CH(NH_2){-}COOH \\ \;| \\ CH_2 \quad {-}COOH \end{array}$

Glutamic acid or α-aminoglutaric acid, $\begin{array}{l} CH_2{-}CH(NH_2){-}COOH \\ \;| \\ CH_2{-}COOH \end{array}$

(C) Diaminomonocarboxylic Acids

Arginine or α-amino-δ-guanidine valeric acid—

$$HN{=}C\begin{array}{l} \diagup NH_2 \\ \diagdown NH{-}CH_2{-}CH_2{-}CH_2{-}CH(NH_2){-}COOH \end{array}$$

Lysine or α-ε-diaminocaproic acid—

$$CH_2(NH_2){-}CH_2{-}CH_2{-}CH_2{-}CH(NH_2){-}COOH.$$

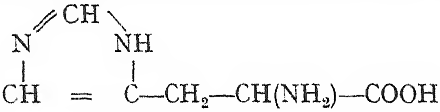
Ornithine or α-δ-diaminovaleric acid, $(H_2N)CH_2CH_2CH_2CH(NH_2)COOH$.

(D) Diamino-hydroxy-monocarboxylic Acid

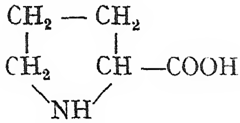
Caseinic acid or diaminotrihydroxy-dodeanic acid, $C_{11}H_{16}(OH)_3(NH_2)_2COOH$.

(E) Heterocyclic Compounds

Histidine or β-iminazole-α-aminopropionic acid, $C_6H_9O_2N_3$,—

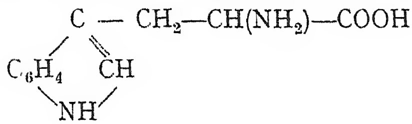


Proline or α-pyrolidine carboxylic acid,



Hydroxyproline or hydroxypyrolidinecarboxylic acid, $C_5H_9O_3N$.

Tryptophan or β-indole-α-aminopropionic acid, $C_{11}H_{12}O_2N_2$,—



Several of the above substances exist conjugated in the protein molecule in an optically active form.

The separation of a mixture of any or all of the above substances, *i.e.*, a mixture such as results from a protein hydrolysis, is a very complex and in many respects an unsatisfactory process.

Emil Fischer introduced (1901) a new method for the separation of these acids which depends on the fractional distillation *in vacuo* of their esters, and which is now commonly known as the ester method. The method, though not really quantitative, has enabled us to obtain a knowledge of some 70% of the total hydrolysis products, and has demonstrated that phenylalanine, serine, and alanine (see list of amino acids), are present in all proteins. The method also demonstrated the presence of two new compounds—proline and oxyproline.

With the exception of glycine, all the amino acids contained in proteins are optically active, and this further enhances the difficulty of synthesis.

The compound mentioned previously as synthesised by Fischer, if it had been found in nature, would have been described as a protein. Up to the present, however, no naturally occurring protein has been synthesised.

THE HYDROLYSIS OF THE PROTEINS

A brief account of the general methods employed in protein hydrolysis is given, almost all of which are directly applicable to the hydrolysis of keratin, which is considered in detail later.

Hydrolysis with Hydrochloric Acid

(i.) *Concentrated Acid*—The hydrolysis is carried out by heating the protein with three times its quantity of concentrated acid (density=1·19). It is boiled for from 6 to 24 hours, depending on the particular protein. The product is filtered and the acids are to be found in the solution.

(ii.) *Dilute Acid*—Van Slyke[6] has shown that hydrolysis may be equally well effected by boiling the protein with from 10 to 20 parts of 20%

hydrochloric acid from 20 to 50 hours. Van Slyke[7] has shown also that hydrolysis is usually effected using $3N$ acid in an autoclave at 150° C. (use thirty times as much acid as protein).

(iii.) *Alcoholic Hydrochloric Acid* has been used, but the results are not so good as when the aqueous acid is used.

Sulphuric Acid

Sulphuric acid of 30% strength is an effective agent, the amount used being six times the quantity of the protein and the boiling continued for about twenty-four hours.

Hydrolysis with Hydrofluoric Acid

Hugounenq and Morel[8] have employed hydrofluoric acid and find that the results depend on the strength of the acid; the stronger the acid the greater is the amount of complex polypeptides. Prolonged boiling with dilute acid is required to effect complete hydrolysis.

Hydrolysis with Alkalis

Abderhalden and his co-workers[9] have compared the hydrolysis by acids and alkalis, using hydrochloric acid, 25% sulphuric acid, 25% sodium hydroxide and saturated baryta. Proteins are not generally hydrolysed by boiling with alkali, and if used alkali will destroy arginine and cystine. Abderhalden and Brahm[10] found, however, that a body obtained from silk was resistant to hydrolysis by acid, but could be completely hydrolysed by alkali.

Hydrolysis by Enzymes

Hydrolysis by the action of proteoclastic enzymes is never complete. Fischer and Abderhalden[11] have shown that the portion unattacked contains all the phenylalanine and proline present in the protein molecule. The enzyme hydrolysis, however, is of use for the discovery of new units in the protein molecule.

THE REACTIONS OF KERATIN

The colour reactions of keratin and of proteins in general are very characteristic.

(i.) Solid proteins are coloured deep yellow by a solution of iodine.

(ii.) Treatment with nitric acid (density=1·2 to 1·25) gives a bright yellow colour. The coloration is due to the formation of a yellow substance of indefinite composition, known as xanthoproteic acid. This latter is soluble in ammonium hydroxide and fixed alkali hydroxides with orange red or brownish-red colour. The reaction is probably due to presence of a radical containing the benzene ring. With gelatin this reaction is negative or very faint.

(iii.) When a solution of a protein is treated with Millons' reagent,* a white precipitate forms which turns brick red on boiling, and the supernatant liquid becomes red after a time. Solid proteins become red when boiled with Millons' reagent. Gelatin yields reaction faintly or not at all. The reaction is due to the presence of tyrosine groups, which are absent in gelatin and protamines. The reaction does not take place in presence of sodium chloride.

**Preparation of the Reagent*—Treat mercury with an equal weight of nitric acid (density=1·4) when the action slackens, apply gentle heat till complete solution is effected. Dilute solution with twice its volume of water, allow to stand for some hours, and decant from deposit which forms. The liquid thus prepared is a solution of mercurous nitrate, holding nitrous acid in solution to the presence of which its action is partly due.

(iv.) The *Biuret* or *Piotrouski* test—If a few drops of a dilute copper sulphate solution be added to the solution of an albumin or globulin, a precipitate of copper albuminate will be produced. On the addition of an excess of sodium or potassium hydroxide to the liquid, the precipitate will dissolve with production of a fine violet coloration. Using ammonium hydroxide, a blue coloration is produced. M. Becke[12] has used this reaction for determining the degree of action on wool of various agents employed in mordanting, dyeing, &c.

(v.) The *Adamkievicz* reaction—This colour reaction is due to the presence of the tryptophan group. As applied by Hopkins and Cole, the test consists in treating the protein solution with a few drops of a dilute solution of glyoxylic acid, and then gradually adding one volume of concentrated sulphuric acid. If tryptophan be present, a reddish-violet colour is produced.

Numerous other colour reactions depending upon formation of tryptophan are known. A positive reaction is obtained with all proteins except gelatine and the protamines, though cylcopterine, a protamine, however, contains tryptophan groups, and consequently gives a positive reaction.

(vi.) *Molisch's* reaction—A violet colour is produced on adding strong sulphuric acid to a protein solution containing an alcoholic solution of α-naphthol. This reaction is given by all proteins which contain carbohydrate complexes and depends upon the production of furfurol by the action of the mineral acid.

THE DEGRADATION PRODUCTS OF KERATIN

Two main lines of attack have been directed on the keratin molecule, namely—

(i.) Hydrolysis.
(ii.) Mild oxidation.

The various resulting products have been isolated, characterised, and in some cases quantitative results have been obtained. The yields of various products differ greatly according to the exact conditions employed, and nothing but general agreement as to the presence of certain degradation products is to be found in a search of the literature. This difficulty is further apparent when one considers the immense number of "keratins" (or keratin substances) which have been used by different investigators.

The Action of Water

In a series of papers, Heiduschka and Komm[13] have investigated the action of water on horn clippings heated in sealed vessels, and also the action of heat on horn clippings at atmospheric pressure, in a vacuum and in sealed vessels. The temperature of initial partial degradation varies with the time of heating and the conditions of the experiment, and among the volatile products are sulphuretted hydrogen, ammonia, and sulphur compounds.

Using the iron method of Siegfried, a peptone has been isolated from the products of the partial hydrolysis of horn, having the empirical formula $C_{11}H_{20}O_5N_3$ and $[\alpha]_{20}^{D} = -15{\cdot}5°$ (approx.).

The proteoses obtained from the partial hydrolysis of horn have been fractionated, and the solubilities and reactions of the various hetero-keratoses, protokeratoses, and deuterokeratoses investigated.

R. Bauer[14] has shown that when keratin obtained from horn shavings is heated with water in sealed tubes at 150° C. for 24 hours, considerable amounts of sulphuretted hydrogen and a second volatile sulphur compound, presumably methyl mercaptan, are formed (*cf.* above), and the solution contains *two* compounds corresponding with Neumeister's[45] atmidalbumin and atmidalbumose, which Bauer terms atmidkeratin and atmidkeratose. They are readily obtained by concentrating the solution and saturating it with powdered sodium chloride, when atmidkeratin is precipitated. The filtrate from this precipitate, on treatment with hydrochloric acid saturated with sodium chloride, yields first a mixture of the two compounds and then atmidkeratose. The compounds are slowly acted upon by pepsin and trypsin.*

Hydrolysis of Keratins, using Dilute Acids

A fair amount of work appears to have been carried out on the hydrolysis of keratin using dilute acids. The general conclusion which may at once be drawn is that keratin is a mixture of proteins. This is evident when the large number of hydrolysis products is noted, and also from the fact that from some types of keratin, products are obtained which are not obtained, at least under conditions yet employed, from other types of keratin.

Buchtala[15] has hydrolysed the keratin from white human hair and obtained the following products (*see* "List of Hydrolysis Products" for structure)—

Glycine	9·12%†	Phenylalanine ...	·62%
Alanine	6·88%†	Tyrosine	3·3 %
Leucine	12·12%	Cystine	11·55%†
Glutamic acid	8·0%		

Buchtala[16] has also hydrolysed the keratin obtained from the scales of the *Manis japonica* (a species of ant eater), and also that from snake skins. The general result of the investigation may be taken to show that the nitrogen content of these various keratins is fairly constant, but they differ widely in the proportions of the individual amino acids which they contain. Snake skin keratin contains a high proportion of tyrosine and leucine. Keratin of the scales of the *Manis japonica* yields an unusually large proportion of alanine and tyrosine.

Abderhalden[17] and co-workers have worked on keratins from horns and wool of sheep, from horse hair, goose feathers, and hog bristles. None of the results agrees with the other, and the conclusion is that keratin is a mixture of proteins. The results obtained from 100 grams of ash-free, water-free, and melanin-free keratin, prepared from horse hair, on hydrolysis are—

Glycine	4·7 grams	Glutamic acid	3·7 grams
Alanine	1·5 ,,	Tyrosine	3·2 ,,
Aminovaleric acid ...	·9 ,,	Serine	·6 ,,
Leucine	7·1 ,,	Pyrolidine-2-carboxylic acid	3·4 ,,
Aspartic acid	·3 ,,		

*Compare Thorpe's "Dictionary" under keratin, where it is stated that "Keratin resists the action of pepsin and trypsin." Also Allen, vol. VIII., p. 676. "Keratin is not acted upon either by pepsin or trypsin."

The statement that keratin is not acted upon by pepsin is correct, but the second is probably erroneous, since keratoids undergo digestion in the small intestine, keratin having been used for coating pills intended to act on the small intestine.

†The amounts of cystine, glycine, and alanine are abnormally large, the general conclusion being that hair keratin closely resembles that from sheep's wool.

100 grams of ash-free and water-free keratin from goose feathers yielded on hydrolysis—

Glycine	2·6 grams	Aspartic acid	1·1 grams
Alanine	1·8 ,,	Tyrosine	3·6 ,,
Aminovaleric acid ...	0·5 ,,	Serine	·1 ,,
Leucine	8·0 ,,	Pyrolidine-2-carboxylic acid	3·5 ,,
Glutamic acid	2·3 ,,		

A promising method of attack upon the nature of the structure of the keratin complex has recently been made by Abderhalden and Komm[18] who have attempted a gentle decomposition of hog bristles. It would appear that only by a gradual breakdown and recognition of the earliest breakdown products can any real attempt be made upon the structure of the keratin complex. The experimental procedure was as follows—

(*a*) 400 grams of hog bristles were heated with 2,000 cc. 1% hydrochloric acid in an autoclave at 120° for five hours, the product neutralised with ammonium hydroxide, evaporated to dryness, mixed with sand, and extracted with ethyl acetate. The following were obtained from the extract—

d-Alanylglycine anhydride, m.p. 250° (decomp.);

Prolyl-leucine anhydride, m.p. 153° $[\alpha]_{20}^{D\circ} = -46{\cdot}3$ (in alcohol), (apparently partly racemised);

1-Prolyl-*d*-valine anhydride, m.p. 250°–252°; and

A compound, $C_{14}H_{23}O_3N_3$, of m.p. 180°–182°, which yields on hydrolysis, proline, leucine, and alanine, and is formed from these by loss of 3 molecules of water.

(*b*) Using 70% sulphuric acid as hydrolysis agent for seven days, the only pure compound isolated was—

1-leucylserine $[\alpha]_{20}^{D} = -44{\cdot}3$ (in water).

(*c*) From product of hydrolysis, using 70% H_2SO_4 for 14 days, a valyvaline, m.p. 255°–260° $[\alpha]_{20}^{D} = +3{\cdot}5°$ (in water), was obtained.

In both cases, however, other scission products were shown to be present.

Degradation Products Formed by Oxidation

Oxidation with Hydrogen Peroxide—Breinl and Baudisch[19] have heated keratin obtained from human hair with 30% hydrogen peroxide, and obtained the following products—

Sulphuric acid, nitric acid, sulphur, carbon dioxide, acetic acid, oxalic acid, succinic acid, acetaldehyde ammonia, and small amounts of amino acids.

Glycine, alanine, leucine, aspartic acid, and cystine are oxidised when heated with 30% hydrogen peroxide, yielding ammonia, carbon dioxide, aldehydes, and organic acids. Tyrosine is not oxidised. It appears that a milder treatment would have been very informative, as giving some idea of the initial break-down products. Mild oxidation, such as carried out in investigation of the structure of Balbiano's acid (Rothstein, Stevenson, and Thorpe[20]), or oxidation of terpene products, *e.g.* the successive oxidation of α-terpineol, giving eventually terpenylic acid. The use of potassium ferricyanide as a mild oxidising agent, Wallach,[44] does not appear to have been attempted (see H. D. Dakin[21]).

The State of Combination of Sulphur in Keratin

P. N. Raikow[22] has examined the action of phosphoric acid on wool and

not containing much grease, &c., and approximating to wool keratin) were placed in a stoppered bottle of 300 cc. capacity with phosphoric acid (sp. gr.=1·7). The wool becomes brown after 16 hours, and on removing the stopper a strong smell of sulphur dioxide is noticed. After two months, the contents of the bottle are changed to a dark brown, thick, homogeneous liquid, and evolve a very powerful odour of sulphur dioxide.

In the opinion of the author, this proves that part of the sulphur in keratin is combined directly with oxygen. Human hair behaves in much the same way, though the action is somewhat slower. One gram of each of the following substances, sulphuric acid, potassium methyl sulphate, sulphanilic acid, &c., allowed to remain ten days in stoppered bottles with 20 cc. of phosphoric acid, did not in any case evolve sulphur dioxide. The conclusion is reached that the sulphur in the keratin molecule (?) is not combined as a sulphate or sulphonic acid, but probably in a sulphite-like form.

A further paper on the above subject is due to Baudisch,[23] who has repeated the above work of Raikow using wool, and has substantiated his results. S. R. Trotman, E. R. Trotman, and R. W. Sutton,[23a] in a paper of recent date, have repeated the above experiment of Raikow with negative results, and further organic sulphides or mercaptans could not be obtained by the action of alkali on wool as stated by Chevreul. In addition (*cf.* above paper of Breinl and Baudisch), the oxidation of the sulphur to sulphur trioxide has been accomplished by using hydrogen peroxide. When, however, the wool is *first chlorinated*, no trace of sulphur dioxide is observed on treatment with phosphoric acid.*

The Oxidation of Keratin Sulphur and Cystine Sulphur by Potassium Permanganate

Lissizin,[24] in comparative experiments, has shown that a larger amount of sulphur is split off from cystine as sulphuric acid than from keratin (keratin prepared from hair). In the oxidation of keratin, the bulk of the sulphur remains in an organic combination soluble in water only, 10% being converted into sulphuric acid, whereas 47% of sulphur in cystine is converted to sulphuric acid.

In an earlier paper, using permanganate as oxidising agent, Lissizin[25] has shown that small quantities of azelaic acid are produced. From 240 grams of keratin, ·0468 grams of acid were obtained. (For further work on sulphur see section on wool keratin below.)

In a paper, "New Studies on Keratin," Unna and Godolety[26] describe a method of separation of keratin substances. They state, in agreement with all other work on the subject, that horn and similar substances, such as human epidermis, are not uniform in character, but can be separated by treatment with fuming nitric acid, or still better with sulphuric acid and hydrogen peroxide, into three constituents. The three constituents are designated Keratin A,† Keratin B, and soluble albuminoids.

Keratin A represents the most resistant and is not attacked by the strong acid nor by dilute alkali. It constitutes the epithelial cells, and was found

*It seems probable that during the process of chlorination we get oxidation of the "sulphite-like" groupings to sulphate-like groupings, and consequently the above result is to be expected. In other words, one effect at least of chlorination is oxidation.

†The use of the term "keratin" for the above oxidation and decomposition products is unjustifiable, when one considers the original meaning and significance attached to the word "keratin."

to contain on the average—C=53%, H=7%, S=1·75%, N=14%, and Ash=·6%.

Keratin B is precipitated from the acid solution by water and is soluble in dilute alkali, and contains about 5% less carbon than Keratin A. Horn contains about 6% Keratin A and 30% Keratin B. The per cent. of sulphur is not so high as is usually supposed to be the case.

USES OF KERATIN

The uses of keratin in the form of "wool," horn, &c., &c., are too widely known to require elaboration. Strictly speaking, they cannot be designated as keratin; they are keratin plus impurities. Keratin, as such, has been converted into useful products which can be used instead of casein for many purposes, and numerous patents have been taken out, *e.g.*—

French Pat. 360,895, 23rd Dec. 1905,[27] is as follows—100 kilos. of horn scraps, hair, &c., are treated for ten days at the ordinary temperature with 200 kilos. of 15% hydrochloric acid. The acid is drawn off and the residue, after washing with water, treated with 100 kilos. of 6% sodium hydroxide solution. At the end of 24 hours, an aqueous solution of 2 kilos. of potassium permanganate is added and the mixture allowed to stand for a further 12 hours. The residue is then washed and subjected to a pressure of 400 atmospheres. An alternative method is to pass carbon dioxide into the alkali solution, decant, and evaporate the solution. The product is finally clarified by means of hydrogen peroxide or permanganate, and may be used in place of casein for a variety of purposes. A patent, embodying a very similar process, is U.S.P. 926,999, 1909.[28]

Keratin substances are converted into digestible albumoses and peptoses containing sulphur by treatment with dilute mineral salts at moderate temperatures. The reaction is complete and the albumoses and peptoses are isolated, when a diluted sample, after treatment with phosphotungstic acid, or other reagent for albumoses, gives a filtrate containing but little amino acid.

Thermoplastic keratin compounds have been obtained by mixing intimately keratin with β-naphthol and subjecting the mixture to heat and pressure (U.S.P. 922,692, 1909[29]).

GENERAL PROPERTIES OF "KERATINS" (KERATOIDS)

Heated in the dry state, keratoids swell up, char, and evolve a characteristic odour of burnt feathers. Most of the keratoids are hygroscopic, taking up a large proportion of water without affording any indication of its presence* beyond the increase in weight of the substance. No systematic work appears to have been done with respect to the amount of water taken up by keratoids in atmospheres of varying humidity, except in the case of wool and gelatine. It would appear desirable to know, for instance, what is the regain of hair, horn, scales, &c., at various degrees of humidity, and to compare these regains one with another, and in particular with the definitely known regains of wool. The writer would suggest a phase rule study of the problem, on the lines of the work due to Cumming[30] on the hydrates of sodium carbonate, with a view to settling the point whether the taking up of moisture is merely a physical process, *i.e.* due to sorption,

*When subjected to mechanical tests, *e.g.* stress strain detns., the presence of moisture is found to alter the stress strain curve.

or has some chemical basis, or, further, the process may be compounded of the two.

The *keratoids* are quite insoluble in alcohol and ether, and are not much affected by boiling with water at the ordinary pressure; but when heated under pressure for a considerable time to 150°–200° C. they dissolve (*cf.* Bauer *supra*), with evolution of hydrogen sulphide to a turbid solution which does not gelatinise* on cooling, and gives on evaporation a residue insoluble in water.

Treated with alkalis, keratin substances swell up and are entirely dissolved by boiling alkaline solutions. Ammonia acts similarly but less strongly. On the addition of excess of acid to the solution of keratin in an alkali, a white flocculent precipitate is formed and hydrogen sulphide is evolved. In the case of wool, caustic soda solutions of 5–60° Tw. rapidly disintegrate wool, and when wet the wool can be drawn out to nearly twice its length, and on drying is very felted. Sodium hydroxide of 70° to 100° Tw. causes no felting and maximum tensile strength is observed at 82° Tw. (Washburn,[33] Matthews[34]).

Merrill,[32a] working on the action of sulphide on purified skin or hair, has arrived at the following conclusion—

(1) There is a reaction between keratin and the SH ion.

(2) This reaction so alters the structure of the protein that the residues are more readily attacked by the hydroxyl ion (*i.e.* by alkalis).

Bergmann and Stather,[32b] in a recent paper, have studied the action of sulphides on wool. Wool (250g.) was treated with a solution of sodium sulphide, acidified with hydrochloric acid, the water and the hydrogen sulphide being then removed under reduced pressure. The dry product was refluxed with concentrated hydrochloric acid, solution filtered, decolourised with animal charcoal, and neutralised with alkali. The precipitate contained 6·42% sulphur, corresponding to 9·7 grams of cystine. Wool not subjected to sodium sulphide treatment gave a precipitate containing 7·56% sulphur, corresponding to 13 grams of cystine. Decomposition of the cystine was much greater in the case of horse hair which had undergone the sodium sulphide treatment.

Treated with cold glacial acetic acid, horny substances swell up, and on boiling are largely dissolved. Whalebone is converted into a gelatinous substance by boiling with concentrated acetic acid, but tortoise shell is little changed by such treatment.

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*In this connection the work of Gardner[31] is of interest, since it is not in entire agreement with the above, which is usually found in the literature. Gardner extracted 50 grams of wool with 1,500 cc. of water, and obtained ·825 gram solid residue, horn-like substance, *soluble in water* (*cf.* above), but insoluble in alcohol and containing a mere trace of mineral ash. The substance *was distinctly alkaline*, possessed feeble reducing properties, and decolourised an acid solution of potassium permanganate. The substance, called by Gardner "Wool Gelatine," has some function in mordanting with bichromate. It increases the amount of chrome fixed and retards the reduction of the mordant observed in old chrome baths.

Herz,[32] using 644 grams of wool (scoured in soap and soda, washed, acidified, extracted with ether, neutralised with ammonia, and washed), boiled with 16 litres of water for one hour (in two lots of eight litres), and on evaporation obtained ·71% of wool gelatine. From a second extraction he obtained ·4% wool gelatine. The properties are compared with those of a 1% gelatine solution, and the two are distinguished by applying the basic lead acetate test. There is a precipitate with wool gelatine, none with ordinary gelatine.

He further shows that wool gelatine is a mixture of three substances and states it is *acid towards litmus* (*cf.* Gardner *supra*).

On treatment with cold concentrated sulphuric acid, the keratoids swell up, and on heating dissolve more or less completely. The solution appears to contain syntonin, for on dilution with water and addition of potassium ferrocyanide it yields a flocculent precipitate and also gives a white flocculent precipitate when exactly neutralised.

When keratin is treated with chlorine water or bromine water, the substance undergoes no change in external appearance (this may be true of horn, &c., but is certainly not true of wool, *e.g.* work of B.R.A., Trotman, &c.), but after drying it is harsh to the touch and then dissolves in ammonia with evolution of nitrogen.

If chlorination* be excessive (work already done and in progress), a considerable portion, up to 30%, of wool substance in the case of wool keratin is destroyed.

Treated with fuming hydrochloric acid, most keratins swell up to a jelly and subsequently dissolve, though hair is unaffected by such treatment.

Other reactions and properties of keratin have been given in detail under the headings "Reactions of Keratin," "Hydrolysis Products," above.

Wool-keratin is of especial interest, and as a further illustration of the variability of the amounts of the elements present in a keratin, *i.e.* not taking account of the possible variation in configuration, the following data due to Bowman[35] are given—

	C	H	N	O	S	Loss†
Lincoln Wool	52·0	6·9	18·1	20·3	2·5	0·2
Irish Wool	49·8	7·2	19·1	19·9	3·0	1·0
Northumberland Wool ...	50·8	7·2	18·5	21·2	2·3	—
Southdown Wool	51·3	6·9	17·8	20·2	3·8	—
Mean	50·27	7·05	18·37	20·40	2·90	—

The mean of Bowman's analyses of wool-keratin correspond to the empirical formula $C_{43}H_{71}O_{13}H_{13}S$. It is of interest to note that in a paper on the sorption of hydrochloric and sulphuric acids by wool, Mills and Takamine[36] speak of wool-keratin as a substance of definite composition having the empirical formula $C_{42}H_{157}O_{15}N_5S$. This formula is based on analyses taken from Gmelin's "Handbook of Chemistry," but Whitely[37] has pointed out that owing to a misprint the percentages of nitrogen and hydrogen were transposed. The corrected average composition of keratin, according to analyses in question becomes C=49·96%, H=7·11%, N=16·65%, S=3·39%, and O (by diff.)=22·89%. The figures correspond to a formula $C_{41}H_{71}O_{14}N_{12}S$.

The only criticism which is necessary is that even with the finest apparatus available at the present day for ultimate analysis, no one could say with any degree of certainty whether the formula of keratin was, say, $C_{41}H_{70}O_{14}N_{12}S$, or $C_{41}H_{72}O_{14}N_{12}S$, assuming for the sake of argument that we could determine absolutely all the elements except oxygen.

It is of interest to note that lanuginic acid (first isolated by Champion[38] and further studied by Knecht and Appleyard,[39] obtained by Knecht on

*N.B.—The effect of chlorination is at present being investigated in greater detail.

†The loss in the first two analyses represents the mineral matter. In the last two this is included in the carbon.

treating wool with baryta under pressure at 170° C., has the following composition—C=41·61, H=7·31, N=16·26, S=3·35, O=31·44%, and that horn and human epidermis give very similar products when heated with water under pressure at 200° C.

With regard to the sulphur in wool-keratin, the work of Chevreul is of interest. Chevreul found that by treating wool with alkalis, the greater part of the sulphur is removed, but he was unable to extract the whole of it in this manner. Steeping wool 28 times in lime-water for 24 hours each time and washing with hydrochloric acid between each treatment, he reduced the sulphur content to ·46%. This wool was not blackened by boiling with lead acetate and excess of alkali hydroxide. (*See* reference 23a.)

Knecht (*supra*) found that lanuginic acid also gives a negative reaction with the alkaline lead reagent, from which fact he considers it probable that the *residual sulphur* of wool exists as lanuginic acid, or as some substance which readily yields lanuginic acid as a first product of its decomposition by reagents.

According to Prud'homme,[40] the sulphur in the wool is probably combined either as—

$$\mathrm{N{-}\overset{S}{\overbrace{C_n\,H_{2n}\,CO}}} \qquad \text{or} \qquad \mathrm{\overline{N{-}C_n\,H_{2n}\,CS}}$$

and is also contained in the natural colouring matter of the wool.

S. R. Trotman, E. R. Trotman, and R. W. Sutton[40a] have determined the sulphur content of various wools and find that results agree closely, the mean value being 3·22% of sulphur, and within the limits of the experiments described in the above preliminary notice, the authors believe that the amount of sulphur in wool is constant.

The behaviour of wool with coal-tar colouring matters suggests that wool-keratin has the constitution of an amino acid, in which case it should be possible to obtain the corresponding *diazo-compound*. The subject has been studied by Richard,[41] who apparently obtained some product resembling the diazonium derivatives, but Knecht[39] considers the theory to be untenable.

Fort and Lloyd[42] have attempted to condense the "assumed" amino group* in wool keratin with β-naphtho-quinone-4-sulphonic acid (potassium salt). This compound condenses with a number of amines giving coloured condensation products. With wool a brown compound (?) is formed, which changes in colour when treated with acid or alkali. They further show that alkali treatment increases the reactivity of the condensation, and they assume that alkali treatment develops the amino grouping.

The hydrolysis of wool by acids or alkalis is assumed to develop free amino groups according to the equation—

$$\mathrm{\overset{W}{\overbrace{NH{-}CO}}} + H_2O \rightleftharpoons \mathrm{\overset{W}{\overbrace{NH_2{-}COOH}}}$$

On the whole one is compelled to arrive at the conclusion that little real evidence as to the presence of the amino group in wool is to be obtained from the action of substances capable of forming condensation products.

*In this connection and for a review of the whole problem of the action of dyestuffs on wool samples treated in various ways, *e.g.* with alkalis, nitrous acid, quinone, &c., see E. R. Trotman.[43]

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14—THE CHEMICAL ANALYSIS OF COTTON

xi.—THE ABSORPTION OF METHYLENE BLUE FROM BUFFERED SOLUTIONS

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I.—INTRODUCTION AND SUMMARY

In a previous communication[1] methods were described for the estimation of the absorption of Methylene Blue by cotton and the value of the measurement for the examination of bleached material was illustrated. It was shown among other things that accurate measurement necessitated great care in the preliminary washing of the cotton, since traces of acid or alkali which might occur in technically bleached material greatly influenced the observed value of the absorption, and a similar disturbance is caused by traces of alkali dissolved from the surface of storage bottles or other glass apparatus used in the determination. This effect, which is due to changes of hydrogen ion concentration, has been more closely examined in the work here described and a slightly modified method of measurement is given on page T130, rendering unnecessary the careful and time-consuming operation of washing which formed the chief disadvantage of the earlier method for routine purposes.

The new method prescribes the use of a solution of pure Methylene Blue hydrochloride, not in water, but in a dilute aqueous phosphate solution whose buffer action stabilises the hydrogen ion concentration and neutralises the effect of traces of acid or alkali which may be introduced with the cotton or from other sources. The phosphate buffer has been chosen to maintain the Methylene Blue solution at the neutral point (pH 7), whilst aqueous solutions of pure Methylene Blue hydrochloride are slightly acid. It is shown here and in other places that the absorption of Methylene Blue by cotton decreases with increasing acidity of the solution, and it is therefore to be expected that the values obtained from the neutral buffered solution will be higher than previous values recorded for unbuffered aqueous solutions. This is found to be the case and it is shown that the difference is mainly due to the changed hydrogen ion concentration, since the phosphate ion itself exerts little influence upon the absorption under the conditions of the measurement. The specific effect of the anion is much more marked with some other buffer salts than with phosphates, and it is far from true that two Methylene Blue solutions buffered at the same hydrogen ion concentration with different buffer mixtures necessarily yield identical absorption values with the same cotton. This fact does not, however, impair the value of the buffered solution in absorption measurements, since the same standard buffer being always used, the specific effect of the anion can be neglected. The great advantage of the new method is well illustrated by the table on page T132, and it is now being used in this laboratory for all measurements on normal and modified cotton cellulose.

During the course of many routine determinations, difficulty has sometimes arisen owing to the fact that different trade samples of "pure" Methylene Blue hydrochloride yielded different absorption values on the same cotton,

even when the dye content of the sample was determined by analysis and due quantitative allowance made for the impurities present. For such alleged pure samples a content of Methylene Blue hydrochloride has been found varying between 91% and 97%, calculated on the weight of dry material, and in some cases the impurities present exerted a qualitative or specific effect upon the absorption. Although this difficulty is to some extent avoided by the use of the buffered solution, it is recommended that Methylene Blue hydrochloride should always be purified by recrystallisation from water for the purposes of this measurement. By the use of such material in solution buffered with phosphates at pH 7, as here described, little difficulty has been encountered in obtaining standard reproducible absorption measurements.

Much of the work recorded in the previous communication has been repeated and amplified with the buffered solution, but no important modification of the earlier conclusions has been found necessary. In particular, the observation that mercerisation of cotton has little effect upon its Methylene Blue absorption is confirmed, and the point is emphasised since increased affinity for Methylene Blue is sometimes ascribed to increased colloidal dispersion of the cellulose, a view which is at present without experimental foundation.

The investigation has been extended to include oxy- and hydro-celluloses by a study of the effect of variations in the hydrogen ion concentration of the Methylene Blue solution upon the absorption of these modified celluloses. It is shown that the enhanced absorption characteristic of certain oxycelluloses suffers a rapid decrease with increasing acidity of the Methylene Blue solution, the behaviour being similar in this respect to that of normal cotton cellulose. Some hydrocelluloses, such for example as those formed by drying low concentrations of sulphuric acid into cotton at elevated temperatures, are also characterised by increased affinity for the basic dye, but with these the absorption is approximately the same from acid as from neutral solution. It is therefore possible to distinguish between enhanced absorption due to oxidising attack and that due to acid attack, and for this purpose two Methylene Blue solutions are used—the standard solution referred to above, buffered with phosphates at the neutral point (pH 7), and an acid solution of equal concentration in dyestuff prepared by dissolving Methylene Blue hydrochloride in $N/5$ acetic acid (pH 2·7). The two absorption measurements, from neutral and from acid solution, can be carried out on identically the same specimen by washing it free from Methylene Blue after the first measurement, and any uncertainty which may arise owing to non-uniform or local modification of the material to be tested is largely eliminated in this way. The test is described in detail on page T130.

Section II. of this paper describes the materials and methods of measurement used in this work; Section III. contains absorption measurements on cottons of several different growths scoured by a number of different boiling treatments; Section IV. discusses the effect of hydrogen ion concentration upon the absorption of bleached cotton; Section V. its effect upon the absorption of modified celluloses; and Section VI. records some measurements made on mercerised cotton. Finally, in Section VII., a comparison is made between the effect of ash alkali upon the absorption of Methylene Blue by cotton and its effect upon the absorption of the two triphenylmethane dyes, Methyl Green and Malachite Green.

II.—MATERIALS AND METHODS OF MEASUREMENT

Reagents

Methylene Blue Hydrochloride—Commercial "pure" Methylene Blue hydrochloride in the form of well-defined crystals was recrystallised two or three times from twelve times its weight of water. The moisture content of the air-dry crystals was estimated by drying a small portion at 110° C., and the dye content, which was in all cases between 99% and 100% of the theoretical, by titration with titanous chloride, the values so obtained being used for the preparation of the standard solutions described later.

The dye content of various "pure" commercial specimens of the hydrochloride varied between 91% and 97% of the theoretical, exclusive of moisture. In carrying out absorption measurements from aqueous unbuffered solutions, using these commercial "pure" samples, it was sometimes found that the 3% to 9% of impurity present exerted a specific effect upon the absorption for which due allowance could not be made except by carrying out absorption measurements upon a standard bleached cloth; thus, in a previous communication[1] the average value 0·45 was obtained for the absorption of well-scoured American yarns and cloths at an end concentration of 0·2 millimole per litre, but considerably lower values have been obtained since then for the same materials, using more carefully purified Methylene Blue hydrochloride. This difficulty, which has been encountered in other work,[2] and which affects the absolute value of the absorption rather than its relative significance in a series of measurements, is largely overcome by the use of the buffered solution described below, but it is recommended that recourse should always be had to a dyestuff preparation of 99% to 100% purity, such as can readily be obtained by the recrystallisation of commercial specimens.

In the preliminary investigation, the purity of the dye was controlled, not only by analysis, but also by measurements of electrical conductivity. The first recrystallisation of the commercial sample was always accompanied by an apparent fall of specific conductivity, but after two recrystallisations the value 102·2 $ohms^{-1}$ was obtained at 25° C., and a molecular dilution of 200 litres, and further crystallisation was without effect; this value agrees well with that given by Pelet-Jolivet[5] for the pure substance.

Neutral Buffered Methylene Blue Solution—The neutral (*p*H 7) buffered solution used in most of the measurements recorded later was *M*/250 in Methylene Blue, and had the following composition—

Potassium dihydrogen phosphate, KH_2PO_4	6·81 grams.
Normal sodium hydroxide solution, *N*.NaOH ...	29·63 ccs.
Pure Methylene Blue hydrochloride, $C_{16}H_{18}N_3SCl$ ...	1·279 grams.
Water	to 1 litre.

It is intended to use this solution in all future routine measurements of the absorption of normal or modified cotton cellulose.

Acid Methylene Blue Solution—It will be shown that in the examination of certain modified celluloses valuable information can be obtained by means of absorption measurements carried out not only in the neutral buffered but also in an acid Methylene Blue solution. For the latter purpose the following, also *M*/250 in Methylene Blue, was used (*p*H 2·7)—

Pure Methylene Blue hydrochloride	1·279 grams.
N/5 Acetic acid solution	to 1 litre.

Naphthol Yellow S Solution—This was employed for titration of the Methylene Blue solutions and contained approximately 0·6 gram of the

purified salt per litre. Naphthol Yellow S for the preparation of this solution consisted of a commercial "pure" sample of the sodium salt recrystallised from alcohol and water, and dried at 70° C. in vacuo, and the solution was standardised by titration against the neutral buffered Methylene Blue solution or against the acid solution when this was being used. An account of the titration method has already been given.[1] The presence of phosphate or of acetic acid in the solution did not affect the accuracy with which the end point could be observed, and the titrations did not differ by more than 1% from those obtained with pure aqueous solutions of Methylene Blue hydrochloride of equal concentration.

Method of Absorption Measurement

Measurements recorded in this paper were made by the titrimetric method substantially as described in the earlier communication, and it is intended to adopt this procedure in all future routine determinations—

A sample of the air-dry cotton weighing $2{\cdot}50 \pm 0{\cdot}01$ grams was added to 15ccs. of the neutral buffered Methylene Blue solution in a tube of the form previously described, care being taken to ensure thorough wetting. After standing overnight the solution was separated by centrifuging, and 10 ccs. titrated against the Naphthol Yellow S solution. The absorption in millimoles per 100 grams of dry cotton was calculated from the difference in titre of the 10 ccs. before and after immersion of the cotton, and with solutions of the above strength it is numerically equal to about one-fifth of the titre change; it is convenient in routine measurements to adjust the Naphthol Yellow S solution in order to render this relationship exact. Complete exhaustion of Methylene Blue from the solution under these conditions corresponds to an absorption of 2·4, and when measurements are being made on series of oxycelluloses which may be expected to attain very high absorptions, it is advisable to modify the method by taking 1 gram of material for analysis instead of 2·5 grams. Variations in the end concentration of the Methylene Blue solution have a greater effect upon the absorption from buffered than from the previously employed unbuffered solutions, and direct comparisons between measurements carried out with 1 gram and those with 2·5 grams of material cannot therefore be made. Recorded absorption values all refer to "dry" cotton and were calculated on the assumption that the air-dry material contained 6% of hygroscopic moisture, except in the case of measurements made on mercerised cotton when moisture determinations were carried out on separate samples; this assumption is sufficiently accurate for the purpose of the present analytical method. Although the absorption of Methylene Blue from buffered solutions by fully bleached cotton, which has been soured and washed as in normal technical practice, is not generally altered by further acidification of the material (*cf.* Table I.), it is considered advisable to preface the absorption measurement by short acid and water washing, and this has been done in all the experiments described in this paper except where the contrary is stated.

The procedure when the acid Methylene Blue solution is used is identical with that given above for the neutral buffered solution, the Naphthol Yellow S being standardised against the appropriate solution, but it is sometimes desirable to make both measurements on the same specimen, and this can easily be done by stripping the Methylene Blue from the sample after the first measurement. The excess of dye solution is first washed away with water and the sample then treated with successive fresh quantities of $N/5$ acetic acid at the boil until only a slight blue tinge is perceptible in the

material. This treatment is without effect upon the absorption of normal or modified cotton, and the sample can then be washed with water, air-dried, and the second absorption measurement made; it is immaterial in what order the two determinations are carried out.

In much of the work described later, absorption measurements have been made from the buffered solution by both the methods given in the earlier communication,[1] namely, the colorimetric, using $M/2500$ Methylene Blue solutions, and the titrimetric method, using $M/250$ solutions as outlined above, but since similar conclusions were reached by both methods, values given by the latter have alone been recorded. The titrimetric method is preferred partly because the addition of buffer salts to Methylene Blue solutions affects their colorimetric comparison, but also because variations in the end concentration of the Methylene Blue solution are of analytical importance in the colorimetric method owing to the lack of proportionality between the concentration of Methylene Blue and the colour intensity of the solution. In the titrimetric method, when a constant weight of cotton and a constant volume of dye solution of standard initial concentration are used, as described above, the effect of variations in end concentration upon the absorption value is of no analytical importance.

Measurement of the Hydrogen Ion Concentration of Methylene Blue Solutions

In a few cases it has been necessary to check the hydrogen ion concentration of Methylene Blue solutions used for absorption determinations, and for this purpose a quinhydrone electrode was employed which had previously been tested with $M/20$ potassium hydrogen phthalate[3] and compared with a hydrogen electrode in a range of buffer solutions. The two electrodes agreed well in solutions of *p*H less than 9, but at this value the quinhydrone electrode gave a somewhat low result, whilst at *p*H 10·2 a constant E.M.F. was not obtained—behaviour to be expected with this electrode—

Nominal *p*H of Buffer Solution ...		3·97	4·6	7·0	8·0	9·0	10·2
*p*H found	Hydrogen Electrode ...	3·97	4·62	7·00	8·02	8·97	—
	Quinhydrone Electrode	3·97	4·58	6·97	8·02	8·88	9·8–10·3

Although measurements of the hydrogen ion concentration of Methylene Blue solutions made with a hydrogen electrode have been recorded by Rona and Michaelis,[6] the present authors were not successful in attempts to carry out this measurement with a hydrogen electrode of the ordinary stationary type, using a continuous passage of hydrogen, and it was for this reason that recourse was had to the quinhydrone electrode. In $M/100$ Methylene Blue solutions, no stable E.M.F. was obtained with the hydrogen electrode, whilst in $M/500$ or $M/2500$ solutions, although reasonably constant E.M.F.'s were recorded, the corresponding hydrogen ion concentrations were considerably higher than those found with the quinhydrone electrode. Buffered solutions of Methylene Blue showed the same E.M.F. towards the quinhydrone electrode as did the buffer solutions in the absence of Methylene Blue, but with the hydrogen electrode the calculated *p*H was lower in the presence of the dye than in its absence—

Methylene Blue Solution	*p*H found: Hydrogen Electrode	*p*H found: Quinhydrone Electrode
$M/100$ in water	Negative; unstable E.M.F. ...	4·06
$M/500$,, ...	3·57 ...	4·80
$M/2500$,, ...	4·36 ...	5·14
$M/2500$ buffered at *p*H 4·6 ...	4·15–4·30 ...	4·60
*p*H 4·6 buffer solution *alone*	4·62 ...	4·58

The failure of the hydrogen electrode in the presence of Methylene Blue is doubtlessly due to reduction of the dye, since when an electrode which has been used in contact with Methylene Blue is washed with water until the washings are colourless, immersion in an oxidising solution immediately produces a blue colour.

Methyl Green IY and Malachite Green

For comparison with the results obtained by the use of Methylene Blue, a few measurements were made with two triphenylmethane dyes, namely, Methyl Green, as zinc double chloride, and Malachite Green, as oxalate. The purest available commercial products were used, the Methyl Green being assumed to have the composition $C_{26}H_{33}N_3Cl_2+ZnCl_2$ after drying at 110° C., and the Malachite Green the composition $C_{23}H_{25}N_2+1{\cdot}5\ C_2H_2O_4$ after drying at the ordinary temperature over phosphorus pentoxide; absorptions are expressed in millimoles per litre on the assumption of these formulæ.

Cotton samples weighing 2·5 grams were steeped overnight at the ordinary temperature in 50 cc. of $M/1000$ Methyl Green or $M/5000$ Malachite Green, and the change in concentration of the dye solution determined by colorimetric methods.

Neither dye could be estimated by titration with Naphthol Yellow S, and the concentrations chosen for absorption measurement were those found most convenient for colorimetric comparison. The colour intensity of Methyl Green solutions is proportional to the concentration of the dye over a wide range examined, namely, $M/100$ to $M/2500$, but greater difficulty was experienced in the colorimetric comparison of Malachite Green solutions. The shade of solutions of this dye changes with changing concentration, but over the range of low concentrations $M/1000$ to $M/10000$ the disturbance caused by this shade variation is not great and proportionality can be assumed between colour intensity and dye concentration.

III.—ABSORPTION OF METHYLENE BLUE BY BLEACHED COTTON FROM NEUTRAL BUFFERED SOLUTION

Advantages of the Method

In order to show the advantages of the use of a buffered solution compared with that of the ordinary aqueous solution employed in earlier work, a number of measurements were made in which the precautions previously considered necessary were omitted or modified. The errors caused by these omissions are shown in Table I. for both buffered and unbuffered Methylene Blue solutions—

Table I.

Conditions Altered	Cotton Sample No.	% Error in Absorption Measurement: Unbuffered Solution	% Error in Absorption Measurement: Buffered Solution
1 cc. 0·1N NaOH added to 1 litre Methylene Blue	69	+26	−3
1 cc. 0·1N HCl added to 1 litre Methylene Blue	69	−13	±0
Kier boiled and washed with water but not soured	142EK1	+55	+3
	134EK2	+79	+8
	132EK3	+71	+7
Technical full bleach without further laboratory washing ...	69	+35	−2
	67	+37	+3
	182	+51	−1
New Glassware	69	+26	±0
Rapid Acid Wash	132EK3	−20	+5

The table shows that the addition of only 1 cc. of decinormal acid or alkali to a litre of the Methylene Blue solution caused large errors in the absorption from unbuffered solution, but was without significant effect when the buffered solution was used. The plus sign in the table indicates that the absorption was greater than that measured by the normal procedure, the minus sign that it was less; thus, in unbuffered solution, the effect of the slight addition of alkali was greatly to increase the absorption and of added acid to diminish it. When measurements were made on scoured cotton washed off with water after the kier boil, but otherwise untreated, large errors occurred with the unbuffered solution in the direction which would be predicted on the assumption that the cotton still contained free alkali; the errors in the use of the buffered solution were again much smaller. Values are also recorded for materials which had received a technical full bleach with no laboratory washing previous to the measurement. Very considerable errors again resulted with the use of unbuffered solutions, and these were also in the direction which indicates presence of excess alkali on the cotton, or in the solution, although the last operations in the technical treatment of all these samples were souring and washing; it must be assumed either that the technical sour was not very efficient or that the water used for washing was sufficiently alkaline to produce this effect. Alkali dissolved from the surface of new glassware used in the analytical operations also causes a large error which is corrected by the use of a buffered solution. Finally, an example is given of measurements made on a bleached yarn which was washed in the laboratory with dilute acid and distilled water previous to absorption measurement, the washing being, however, less carefully carried out than usual. The "rapid acid wash" referred to in the table consisted in steeping the cotton for an hour in decinormal sulphuric acid, washing twelve times with distilled water, and centrifuging the material between each wash, steeping in water for about three hours, re-washing and drying at room temperature. This operation, which for most purposes would be considered very thorough washing, has yet left sufficient acid in the material seriously to affect the absorption from unbuffered solution. For the complete removal of acid from cotton by water washing, it has frequently been observed that lengthy steeping is of much greater importance than frequent changes of wash water. When the buffered solution is employed, this "rapid acid wash," which can be completed within one working day, may be used with safety.

Influence of Origin of Cotton

It was shown previously with unbuffered solutions that the absorption of cotton scoured by a standard process varies with the origin of the material, different growths yielding different values after identical bleaching treatment, and this is still found to be the case when the neutral buffered solution is used. The absorptions of a number of cottons boiled with 1% sodium hydroxide solution for six hours at 20 lbs. excess pressure are collected in Table II. The values given by Texas cottons are sharply differentiated from those of the Egyptian growths, although the relative difference is not so great as when an unbuffered solution was used, and no significant difference is observed between different Egyptian varieties; for normally well-scoured American cotton, the absorption by the new method falls between 0·8 and 0·9, and for well-scoured Egyptian cotton between 1·0 and 1·1. The table contains measurements made on a number of authentic samples of cottons of known strain grown in India, and it will be seen that native Indian types

(Surat, Sircar, &c.) yield consistently higher values than the strains of American origin (Punjaub American, Cambodia, &c.); in general, however, the cottons grown in India are very variable, a characteristic feature of the chemical properties of this group.

Table II.

Cotton	Sample No.	Variety	Methylene Blue absorption Millimoles per 100 grams	Mean
American	134	Texas	0·89	0·86
	144	,, ...	0·86	
	149	,, ...	0·85	
	147	,, ...	0·85	
Egyptian...	130	Sakel	1·04	1·03
	132	,, ...	1·04	
	148	,, ...	1·03	
	131	Uppers	1·04	
	133	,, ...	1·00	
	140	White Abassi	1·01	
Indian-grown American types	189	Punjaub American 285F ...	1·00	
	190	,, ,, 289F ...	0·96	
	192	Gadag No. 1	0·97	
	191	Cambodia	0·90	
Indian-grown Native Indian types	200	Dharwar No. 1	1·26	
	202	Surat 1027 ALF	1·35	
	203	Sircar No. 14	1·74	
	204	,, No. 25	1·16	
	205	Karunganni	1·50	
West Indian	92	Sea Island	0·98	
Peruvian	143	Tanguis	1·14	

Influence of Conditions of Boiling

By means of unbuffered Methylene Blue solutions, it was shown that, after a normal bleach, cotton absorbs very much less Methylene Blue than in the grey state, and that this change takes place during alkali boiling, the absorption of the bleached material varying with the conditions of the kier boil. This conclusion has been confirmed and amplified by the use of the neutral buffered solution for absorption measurements. In general, and within the limits here employed, the more severe the alkali treatment with respect to duration, temperature (pressure) of boil, and alkali concentration, the lower is the absorption. An open boil results in a considerably higher absorption than does a pressure boil under otherwise identical conditions, as shown in Table III. for a number of different varieties of cotton.

Table III.

Duration of boil, 6 hours. Concentration of Sodium Hydroxide, 1%.

Cotton* Sample No. and Variety.		Absorption, M. Mols./100 gms. After Open Boil.	After Boil at 20 lbs. pressure
133	Uppers, Egyptian	1·45	0·98
132	Sakel, Egyptian	1·51	0·98
150	Tanguis, Peruvian	1·51	1·15
153	Mitafifi, Peruvian	1·42	0·87
151	Pima, American from Egyptian seed ...	1·73	1·14
152	Long-staple Brazilian	1·27	0·85

*These samples had all been chemicked after the kier bo l, an operation which affects the absorption, however, at most to but a slight extent.

The effect of pressure is most pronounced in passing from an open boil to a boil under slight excess pressure (10 lbs.), further increase to 40 lbs. having a relatively smaller effect, as shown in Table IV. by three series of experiments on American, Egyptian, and Indian cottons. The large fall in absorption between the open and the 10 lbs. pressure boil may be due to a better penetration of the material by the alkali rather than to purely chemical causes.

Table IV.

Duration of boil, 6 hours. Concentration of Sodium Hydroxide, 1%.

Kier Boil No. and Pressure		Absorption, M. Mols./100 gms. American Yarn No. 149		Egyptian Yarn No. 148		Indian (Broach) Yarn No. 141
EK11 open ...	...	1·10	...	1·40	...	1·69
EK7 10 lbs.	...	0·95	...	1·22	...	1·47
EK6 20 lbs.	...	0·86	...	1·11	...	1·47
EK8 30 lbs.	...	0·82	...	1·04	...	1·42
EK10 40 lbs.	...	0·83	...	0·99	...	1·39

Increase in the concentration of the alkali from 0·5% to 3% at constant pressure and duration of boiling also produces a slight gradual decrease of absorption.

Table V.

Duration of boil, 6 hours. Pressure of boil, 20 lbs.

Kier Boil No. and Concentration of NaOH		Absorption, M. Mols./100 gms. American Yarn No. 149		Egyptian Yarn No. 148		Indian (Broach) Yarn No. 141
EK23 0·5% ...	...	0·89	...	1·23	...	1·61
EK6 1% ...	...	0·86	...	1·11	...	1·47
EK15 2% ...	...	0·81	...	1·02	...	1·39
EK16 3% ...	...	0·80	...	0·90	...	1·26

Beyond a certain point, determined presumably by the penetration of the alkali through the bulk of the material, the duration of boiling under otherwise constant conditions is without great effect upon the absorption.

Table VI.

Pressure of boil, 20 lbs. Concentration of Sodium Hydroxide, 1%.

Kier Boil No. and duration of Boil		Absorption, M. Mols./100 gms. American Yarn No. 149		Egyptian Yarn No. 148		Indian (Broach) Yarn No. 141
EK14 2 hours ...	...	0·98	...	1·16	...	1·47
EK9 4 ,, ...	...	0·85	...	1·08	...	1·47
EK6 6 ,, ...	...	0·86	...	1·11	...	1·47
EK24 2×6 ,, ...	...	0·81	...	0·97	...	1·32

The effect of employing more rigorous conditions of kier boiling with respect to time, temperature, or alkali concentration, is always more marked with the Egyptian and Indian cottons than with the American sample, and there is evidently a tendency for the absorption to become identical in the three varieties, though this limit is not reached under the conditions so far recorded. When, however, the concentration of sodium hydroxide is raised to 3% in a six-hours' kier boil at 40 lbs. pressure, the absorptions of the three varieties are found to approach one another still more closely.

		Absorption, M. Mols./100 gms. American Yarn No. 149		Egyptian Yarn No. 148		Indian (Broach) Yarn No. 141
EK26 ...	...	0·70	...	0·82	...	0·96

The form in which the cotton is boiled also appears to exert a slight effect upon the resulting absorption, due presumably to its effect upon the ease and efficiency of the penetration of the alkali. The American Yarn No. 149, for which results have already been given, was also available in the form of a woven fabric (No. 166), where it was employed as weft yarn, the warp being spun from the same cotton mixing, and a series of experiments were carried out with this fabric, the results of which are compared below with those of a similar series made with the yarn and already recorded.

Table VII.

Duration of boil, 6 hours. Concentration of Sodium Hydroxide, 1%.

Pressure of boil ...	0	10	20	30 lbs.
Absorption, M. Mols./100 gms.—				
Yarn No. 149	1·10	0·95	0·86	0·82
Cloth No. 166	1·12	1·08	0·98	0·94

The absorption is slightly higher when the cotton was boiled in cloth than when boiled in yarn form.

In the next table some results are collected for a series of samples taken from large batches of American sliver, boiled for 10 hours at 40 lbs. on a technical scale with sodium hydroxide of 2% initial concentration, conditions which are more severe than those generally employed in the bleaching of cotton textiles. The treatment was slightly varied from batch to batch as indicated in the table, several of the samples being the same as those examined in a previous communication. The results with the exception of the last are much lower than those obtained for American cottons under normal bleaching treatment (*cf.* the average 0·86 in Table II. for American yarns boiled with 1% sodium hydroxide at 20 lbs. for six hours), and they offer a further example of the way in which the absorption is lowered by increasing the severity of the alkali treatment, or by improved penetration of the alkali due to looser packing of the cotton or to both causes.

Table VIII.

Cotton Sample No.		Nature of Kier Liquor	Absorption, M. Mols./100 gms.
107R	2% NaOH	alone ...	0·71
110R	,,	preceded by benzene extraction	0·69
73R	,,	preceded by water boil	0·62
76R	,,	+ olein	0·68
97R	,,	+ soap	0·79

The last example in this table shows the increased absorption which results from the presence of soap in the kier liquor, an effect which was noted previously but which is accentuated by the use of the neutral buffered Methylene Blue solution for absorption measurement. Other examples have been observed in which very greatly enhanced absorptions have resulted from the use of soap in technical kier boils, the absorption being reduced to a normal value by washing with acid and extracting with chloroform, and the presence of soap being confirmed by the constants of the material thus extracted.

IV.—EFFECT OF HYDROGEN ION CONCENTRATION UPON THE ABSORPTION OF METHYLENE BLUE BY BLEACHED COTTON

From examples already given it will be evident that the hydrogen ion concentration of the Methylene Blue solution is a very important factor determining the absorption of the dye by bleached cotton. Attempts were made to examine quantitatively the effect of variations in hydrogen ion concentration by using a number of Methylene Blue solutions buffered over the range *p*H 10 to 3, but these attempts failed since the anions in the different buffer salts employed exerted different specific effects upon the absorption. This did not affect the use of a standard buffered solution for analytical purposes, but it did prevent an evaluation of the exact influence of hydrogen ion concentration changes. In order therefore to study this effect closely, measurements were made of the absorption of a bleached cloth (No. 69) from a pure aqueous solution of Methylene Blue hydrochloride and from solutions to which very small additions of sodium hydroxide or sulphuric acid had

been made. After absorption had taken place, determinations of the hydrogen ion concentration of the equilibrium solution were carried out with the quinhydrone electrode, and the results are recorded in Table IX. together with values obtained on the same cotton for the absorption from solutions buffered with phosphate mixtures (*p*H 6 to 8) and from the solution in 0·2*N* acetic acid (*p*H 2·7); in Fig. 1 the absorption is plotted against the *p*H value of the equilibrium solution.

Table IX.

Methylene Blue Solution used		*p*H of Solution after Absorption		Absorption M. Mols./100 gms.
M/250 Methylene Blue buffered with phosphates	250 cc. 0·2*M* KH_2PO_4 + 226 cc. *M*/5 NaOH	7·8	...	0·92
	,, + 206 cc. ,,	7·5	...	0·89
	,, + 148 cc. ,,	7·0	...	0·85
	,, + 76 cc. ,,	6·5	...	0·83
	,, + 28·5 cc. ,,	6·0	...	0·76
15 cc. *M*/250 Unbuffered Methylene Blue	+ 1·0 cc. *M*/100 NaOH	5·8	...	0·70
15 cc. ,, ,, ,,	+ 0·5 cc. *M*/100 NaOH + 0·5 cc. H_2O	5·0	...	0·58
15 cc. ,, ,, ,,	+ 1·0 cc. H_2O	4·2	...	0·49
15 cc. ,, ,, ,,	+ 0·5 cc. 0·01*N* H_2SO_4 + 0·5 cc. H_2O	3·8	...	0·43
M/250 Methylene Blue in 0·2*N* Acetic Acid	... ...	2·7	...	0·31

The curve shows that the relation between *p*H and absorption is approximately linear over this range, very small changes of hydrogen ion concentration having a significant influence upon the absorption. Values obtained from solutions in acetic acid and in the phosphate buffer mixtures also lie near this curve, but it must again be emphasised that this is not the case with many other buffer salts, the effect of the anion often completely obscuring the true hydrogen ion effect. The phosphate ion in this dilution is apparently without great effect upon the absorption from *M*/250 Methylene Blue hydrochloride solution, a conclusion which has been reached from other evidence. Thus when the *p*H 7 phosphate buffer solution in Table IX. was diluted tenfold, its *p*H value was only very slightly affected, and the absorption of Methylene Blue by the cotton from a solution made up in the diluted buffer was only slightly different from that given in the table for *p*H 7·0, although the total phosphate content of the solution had been reduced tenfold.

It will be noticed that the pure aqueous solution of Methylene Blue hydrochloride is acid and remains acid even after the additions of sodium hydroxide recorded in the table; this is due to the hydrolysis of the dye salt (*cf.* Rona and Michaelis[6]).

V.—EFFECT OF HYDROGEN ION CONCENTRATION UPON THE ABSORPTION OF METHYLENE BLUE BY OXY- AND HYDRO-CELLULOSES

It has been observed that the effect of variations in the hydrogen ion concentration of the Methylene Blue solution upon the absorption of oxycelluloses, whether these are characterised by enhanced absorption or not, is similar to the effect of the same variations in the case of normal bleached cotton. Many hydrocelluloses possess no higher absorptions than those of the bleached cotton from which they were formed, and these are generally influenced by changes of hydrogen ion concentration in a similar manner to that observed for normal and oxidised cotton cellulose. There exists,

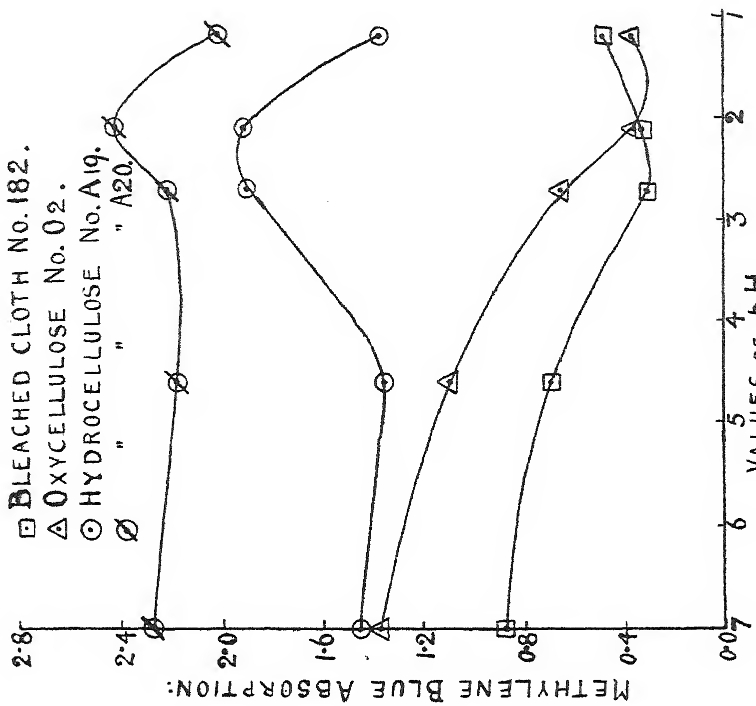
BLEACHED CLOTH No. 182.
OXYCELLULOSE No. O2.
HYDROCELLULOSE No. A19.
" " A20.
METHYLENE BLUE ABSORPTION:
VALUES OF p.H
2·8
2·4
2·0
1·6
1·2
0·8
0·4
0·0
7
6
5
4
3
2
1

FIG. 2

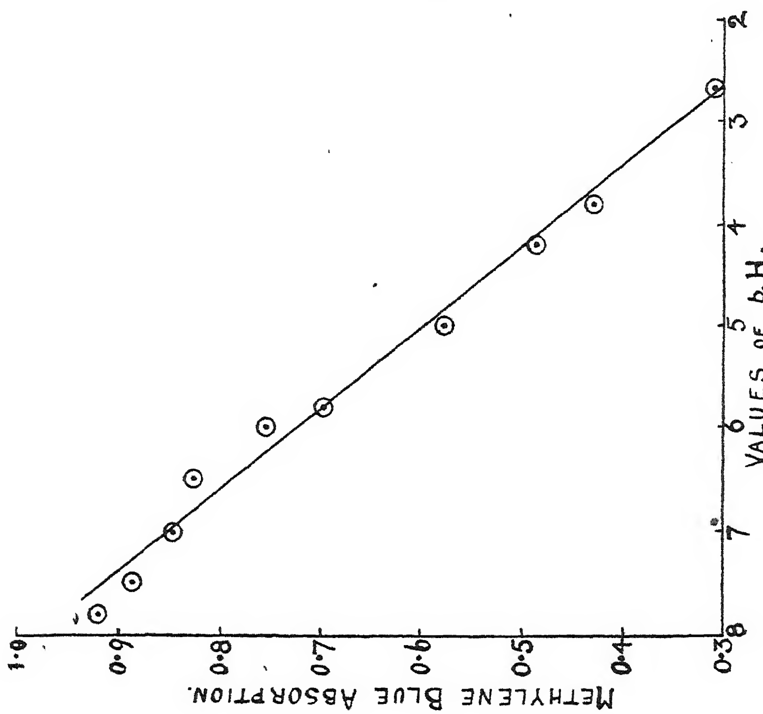
METHYLENE BLUE ABSORPTION.
VALUES OF p.H.
1·0
0·9
0·8
0·7
0·6
0·5
0·4
0·3
8
7
6
5
4
3
2

FIG. 1

however, a type of hydrocellulose, formed for example by drying low concentrations of sulphuric acid into cotton at elevated temperatures, which possesses much higher absorptions than those of bleached cotton, and such enhanced absorptions are influenced by changes of hydrogen ion concentration in a manner very different from that observed in any other case. The absorptions of some samples of modified celluloses have therefore been measured in a range of Methylene Blue solutions of different hydrogen ion concentrations, namely, in the phosphate buffered solution at *p*H 7, in a sodium acetate-acetic acid buffer at *p*H 4·6, in 0·2*N* acetic acid solution (*p*H 2·7), and in solutions 0·01*N* and 0·1*N* in free sulphuric acid (*p*H 2·1 and 1·2 respectively). The results for a bleached cloth, for an oxycellulose and two hydrocelluloses all prepared from it are given in Table X., whilst the absorptions of the four materials are plotted against the *p*H of the Methylene Blue solution in Fig. 2. It is not inferred that the change in absorption on passing from one Methylene Blue solution to another throughout this range is due entirely to hydrogen ion concentration changes, since the difference in quantity and quality of anions present in the various solutions certainly influences the results to some extent.

Table X.

Material	Absorption, M. Mols./100 gms.				
	Phosphate Buffer *p*H 7	Acetate Buffer *p*H 4·6	0·2*N* HAc. *p*H 2·7	0·01*N* H_2SO_4 *p*H 2·1	0·1*N* H_2SO_4 *p*H 1·2
Bleached Cloth No. 182	0·89	0·70	0·31	0·33	0·48
Oxycellulose No. O2 ...	1·38	1·10	0·66	0·36	0·37
Hydrocellulose No. A19	1·46	1·36	1·91	1·92	1·37
,, No. A20	2·29	2·19	2·23	2·42	2·02

The oxycellulose O2, which was prepared by the action of alkaline hypobromite upon cloth No. 182,[2] possessed greatly enhanced absorption when compared with the cloth by the standard absorption method, using the buffered Methylene Blue solution at *p*H 7, and Fig. 2 show that its absorption was affected by changes in the Methylene Blue solution in a similar manner to that observed for the cloth itself. With the exception of the solution in decinormal sulphuric acid, a steady fall in absorption was recorded as the *p*H value of the solution decreased, and this fall was more rapid with the oxycellulose than with the bleached cloth, so that at *p*H 2·1 (0·01*N* sulphuric acid solution) the absorptions of the normal and modified celluloses had become practically identical.

The two hydrocelluloses, A19 and A20, which were prepared by drying 0·1*N* sulphuric acid into cloth No. 182 at different temperatures, also possessed enhanced absorptions, compared with the cloth itself in the neutral buffered solution, but the curves in Fig. 2 show that with increasing acidity of the Methylene Blue solution these absorptions tended to increase rather than to fall as in the previous cases (no particular significance is attached to the exact form of these curves for reasons already stated). The oxycellulose O2, and the hydrocellulose A19, had almost the same absorptions at *p*H 7, namely, 1·38 and 1·46 respectively, whilst at *p*H 2·7 the value for the oxycellulose had *fallen* to 0·66, that of the hydrocellulose having *risen* to 1·91.

In view of these results, a large number of oxycelluloses and hydrocelluloses have been examined, but for the present analytical purposes the examination has been confined to a comparison of the absorptions from Methylene Blue solutions at *p*H 7 (standard method) and at *p*H 2·7 (0·2*N* acetic acid). For bleached cotton and for oxycelluloses of different types

prepared in a variety of different ways, the ratio of the absorption at *p*H 7 to that at *p*H 2·7 was always greater than 2, and the same was true for hydrocelluloses resulting from that type of acid attack which shows no tendency to cause enhanced absorption. Three forms of acid attack have, however, been examined, which lead eventually to enhance absorption, namely, (1) dilute sulphuric acid dried into cotton at elevated temperatures; (2) dilute phosphoric acid similarly dried into cotton; and (3) the steeping of cotton in concentrated sulphuric acid at ordinary temperatures. When enhanced absorption results from any of these causes the ratio of the value obtained at *p*H 7 to that obtained at *p*H 2·7 is less than 2 and generally less than 1. Table XI. records, for example, the absorptions of hydrocelluloses formed by steeping cloth No. 182 at the ordinary temperature, and for a constant time in sulphuric acid of increasing concentrations.

Table XI.

Concentration of H_2SO_4	0	100	200	300	grams per litre.
Absorption at *p*H 7 ...	0·89	0·82	0·83	0·82	millimoles per 100 grams.
,, at *p*H 2·7 ...	0·31	0·28	0·26	0·25	,, ,,
Ratio *p*H 7/*p*H 2·7 ...	2·9	2·9	3·2	3·3	
Concentration of H_2SO_4	400	500	600	700	grams per litre.
Absorption at *p*H 7 ...	0·79	0·79	0·94	1·30	millimoles per 100 grams.
,, at *p*H 2·7 ...	0·27	0·36	0·72	1·76	,, ,,
Ratio *p*H 7/*p*H 2·7 ...	2·9	2·2	1·3	0·74	

It will be seen that with increasing acid concentration the absorption at *p*H 7 falls to a minimum (400–500 gms. H_2SO_4 per lit.), and then begins to rise steadily. At the minimum the ratio of the absorptions at *p*H 7 and *p*H 2·7 falls rapidly, and with acid at 700 gms. per lit. the hydrocellulose absorbs more Methylene Blue from the acid than from the neutral solution; the preparation formed by the action of sulphuric acid at 600 gms. per lit. has an absorption at *p*H 7 very little different from that of the untreated material, whilst in the measurement made at *p*H 2·7 the value of this hydrocellulose is more than twice that of the bleached cotton.

Table XII. shows similar values obtained by drying 0·025*N* sulphuric acid into the cloth for a constant time at increasing temperatures.

Table XII.

Temperature of drying	20°	50°	70°	90°	110°	C.
Absorption at *p*H 7 ...	0·89	0·65	0·59	0·66	0·67	m.mols. per 100 g.
,, at *p*H 2·7 ...	0·31	0·28	0·36	0·68	0·74	,, ,,
Ratio *p*H 7/*p*H 2·7 ...	2·9	2·3	1·6	0·97	0·91	

The values obtained at *p*H 7 within this temperature range never reach that of the unattacked material (0·89), the minimum attained in the initial fall being only just passed at 110° C., so that no enhanced absorption is actually observed, but for measurements made in Methylene Blue solutions of *p*H 2·7, the minimum is attained at 50° C., whilst at 90° C. very greatly enhanced absorptions are found.

Finally, Table XIII. shows the results of a similar series of experiments in which *M*/10 phosphoric acid was dried into the cloth at various temperatures. and the same rapid fall in the absorption ratio is again observed.

Table XIII.

Temperature of drying	20°	50°	70°	90°	110°	130°	C.
Absorption at *p*H 7 ...	0·89	0·83	0·93	1·39	1·64	1·82	m.mols./100 g.
,, at *p*H 2·7 ...	0·31	0·52	0·71	1·19	1·70	2·14	,,
Ratio *p*H 7/*p*H 2·7 ...	2·9	1·6	1·3	1·2	0·97	0·85	

Further details regarding the preparation and properties of these hydrocelluloses will be found in the succeeding communication—"Chemical Analysis of Cotton, Part XII.—Hydrocellulose"—and it is sufficient to say here that measurements of the absorption ratio at *p*H 7 and *p*H 2·7 enable a sharp distinction to be made between enhanced absorption due to the oxidising and that due to the acid attack of cotton.

In adapting the measurement of absorption ratio as a test for technically modified material, it may generally be advisable to carry out the two measurements on identically the same specimen to avoid erroneous conclusions due to non-uniformity of the material. This can be done without difficulty by stripping the Methylene Blue from the cotton after the first determination, as explained on page T130. That this procedure does not introduce serious error is shown by the following figures yielded by two specimens of the bleached cloth No. 182, to obtain which the absorption of the first specimen was measured at *p*H 7, the second at *p*H 2·7, both specimens being then stripped and the absorption of the first determined in solution at *p*H 2·7 and the second in *p*H 7 solution.

Specimen I.		Specimen II.	
Absorption at *p*H 7	0·84	Absorption at *p*H 2·7	0·33
Absorption at *p*H 2·7 after stripping	0·30	Absorption at *p*H 7 after stripping	0·82

The two measurements at *p*H 7 and the two at *p*H 2·7 are in substantial agreement.

VI.—THE ABSORPTION OF METHYLENE BLUE BY MERCERISED COTTON

It has previously been stated[1] that mercerisation has no marked effect upon the absorption of Methylene Blue by cotton, and this has now been confirmed by measurements in the range of Methylene Blue solutions used for the investigation of hydro- and oxy-celluloses. The absorption of cloth No. 182 after mercerisation without tension was slightly lower than that of the unmercerised cloth in each solution—

	Absorption, M. Mols./100 gms.				
Material	Phosphate Buffer *p*H 7	Acetate Buffer *p*H 4·6	*N*/5 HAc. *p*H 2·7	*N*/100 H_2SO_4 *p*H 2·1	N/10 H_2SO_4 *p*H 1·2
Cloth 182, unmercerised	0·89	0·70	0·31	0·33	0·48
,, mercerised ...	0·81	0·69	0·27	0·28	0·47

The following results were obtained from trade samples of an Egyptian cotton fabric which had been bleached by different methods and mercerised under tenson—

	Absorption, M. Mols./ 100 gms.	
Bleaching treatment	Mercerised.	Unmercerised.
Hot soaped, pressure boiled, chemicked	1·04 ...	1·13
,, open boiled, chemicked	1·39 ...	1·28
,, chemicked	1·81 ...	1·95

These figures lend no support to the statements of Harrison,[4] Schwalbe,[7] and others, that mercerised cotton is characterised by increased affinity for Methylene Blue.

VII.—THE ABSORPTION OF OTHER BASIC DYES BY COTTON

The work described in this and the earlier paper was carried out solely with the object of exploring the value of Methylene Blue absorption measurements as a means of analytical control in cotton technology. The only

definition attached to the word "absorption" is that derived directly from the method of measurement, which consists in determining the change in concentration of a dye solution when cotton is introduced into it, and one of the most noteworthy results is the discovery of the close correlation which undoubtedly exists between ash alkalinity and the Methylene Blue absorption of cotton; this extends to cottons containing cellulose modified by the action of oxidising agents.[2] A few measurements have been made to determine whether a similar correlation exists between ash alkalinity and the absorption of other basic dyes by cotton.

In Table XIV. there are given the ash alkalinities and the absorptions of Methylene Blue, Malachite Green, and Methyl Green by four different bleached cottons from aqueous (unbuffered) solutions of the dyes. The absorptions correspond to different end concentrations for the three dyes, the concentrations of Malachite Green and Methyl Green being such as could be conveniently determined by colorimetric methods (*cf.* p. T132). It is not therefore intended to make any comparison between the absorptions of the three different dyes by the same cotton, the object of the measurements being to determine for each dye the effect of washing the cotton with acid or of lowering its ash alkalinity. The four cottons in the table had been kier boiled in the form of unspun or loose material with sodium hydroxide soluton of 2% initial concentration at 40 lbs. excess pressure and were then well washed with water in the course of technical operations. They had not been soured and their ash alkalinities (in the column headed "untreated") were on the average higher than is usual in cotton fully bleached for textile purposes; after thorough acid washing (column headed "acid washed") the cottons possessed very low ash alkalinities.

Table XIV.

	Cotton No. 24R		Cotton No. 88R		Cotton No. 155R		Cotton No. 73R	
	Un-treated	Acid washed	Un-treated	Acid washed	Un-treated	Acid washed	Un-treated	Acid washed
Ash alkalinity, milli-equivs/100 g.	1·62	0·02	2·38	0·05	2·41	0·05	0·90	0·09
Absorption, Methyl Green millimols/100 g.	0·72	0·21	1·50	0·22	1·39	0·23	0·43	0·16
Absorption, Malachite Green millimols/100 g.	0·14	0·09	0·30	0·09	0·26	0·08	0·07	0·08
Absorption, Methylene Blue millimols/100 g.	0·75	0·40	0·80	0·41	0·66	0·36	0·49	0·34

The table shows that the absorptions of Methyl Green and Malachite Green were very greatly decreased by the reduction of ash alkalinity which accompanied acid washing, and the order of absorption of both dyes by the untreated cotton is almost identical with the order of ash alkalinity. The apparent large changes of absorption observed on acid washing are, however, not real, but are due to the fact that the cottons before washing contained sufficient soluble alkali to convert considerable proportions of the colour salts into colour bases, which remained partly in the solution and were partly absorbed by or precipitated on the cotton. This effect was readily detected since, the bases being colourless, the introduction of cotton into the dye solution resulted in greatly decreased colour intensity in the liquid without a corresponding increase in the "dyed" shade of the cotton, and

the colour could be partially restored in the solution by separating it from the cotton and warming with dilute acid. The absorption as measured colorimetrically by the change in concentration of the coloured substance includes the whole of the dye which is converted into colour base.

The absorption of Methylene Blue by these samples was also diminished by acid washing, but it is not possible to decide whether the apparent absorption by the untreated cotton is due in part to a precipitation of the corresponding base, since, the latter being as deeply coloured as the hydrochloride, its formation would not be observed.

In Table XV. measurements are given for a cloth which had been submitted to four different technical scouring processes of varying efficiency, each sample having been soured and washed as the last operation in its technical treatment. The ash alkalinities (in the column headed "untreated") were therefore lower on the average than those of the loose cottons in Table XIV., whose technical treatment did not include a sour, but in every sample thorough acid washing produced a further fall of ash alkalinity.

It will be seen that the effect of acid washing upon the absorptions of Methyl Green and Malachite Green was almost negligible, although that of Methylene Blue still suffered an important fall as a consequence of the diminished ash alkalinity. Thus a great difference in behaviour is shown between the samples of Table XV. and those of Table XIV., a difference which can only be due to qualitative differences of the ash alkali. In the series of samples described in Table XIV., the high ash alkalinity was almost certainly due to traces of sodium carbonate, residues of alkali left in the material after the kier boil, whilst in the second series the ash alkalinity was chiefly due to lime and magnesium salts derived from the chemic and from the hard water used during washing. When cotton contains traces of alkali in soluble form, the absorption of basic dyes is high, but the measurement is unreal at least in the case of triphenylmethane dyes owing to the ready formation of the colour bases. On the other hand, the presence of traces

Table XV.

	Sample No. 88		Sample No. 89		Sample No. 85		Sample No. 91	
	Continuous low pressure caustic scour, chemic, sour, and wash		Boiled with water at 30 lbs. excess pressure, sour, and wash		Scoured with caustic soda at 40 lbs. excess pressure, chemic, sour, and wash		As sample No. 89, then caustic scour at 30 lbs. excess pressure, chemic, sour, and wash	
	Un-treated	Acid washed	Un-treated	Acid washed	Un-treated	Acid washed	Un-treated	Acid washed
Ash alkalinity, milli-equivs/100 g.	0·84	0·27	1·03	0·28	1·43	0·27	0·60	0·30
Absorption, Methyl Green, millimols/100 g. ...	0·64	0·61	0·56	0·58	0·52	0·41	0·44	0·43
Absorption, Malachite Green, millimols/100 g. ...	0·20	0·22	0·22	0·20	0·16	0·16	0·14	0·14
Absorption, Methylene Blue, millimols/100 g. ...	1·02	0·90	0·95	0·72	0·96	0·60	0·55	0·45

of insoluble alkalis in cotton has little or no effect upon the absorption of triphenylmethane dyes, but causes an enhanced absorption of Methylene Blue.

The absorptions of all three dyes, determined after acid washing, place the samples of Table XV. in the same order, namely, the order of increasingly vigorous scouring treatment. The lower absorptions of cotton boiled in the loose state compared with that of cotton boiled in yarn and cloth form has already been commented upon (p. T136), and a comparison of Tables XIV. and XV. shows that this behaviour is characteristic of all three dyes.

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15—THE CHEMICAL ANALYSIS OF COTTON
xii.—HYDROCELLULOSE

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INTRODUCTION AND SUMMARY

Under certain conditions, the action of acids upon cotton cellulose produces changes in its physical and chemical properties, the most obvious of which are loss of tensile strength and ultimate disruption of the cotton hair. The name "hydrocellulose" was originally applied to the structureless powdery material obtained as the result of such acid action, but it is now recognised that complete loss of tensile strength does not correspond to any definite stage of chemical degradation, that the properties of powdery hydrocellulose are variable, and that attempts to prepare a chemically homogeneous substance which can be considered as a primary product of cellulose hydrolysis have so far been unsuccessful. It is a debatable theme whether the name "hydrocellulose" should be reserved for such a substance, at present hypothetical, but on grounds of practical convenience the word has been used in this paper to designate any preparation of cotton cellulose (other than cellulose esters), the chemical properties of which have been altered to a greater or less extent by the action of acids. The present position with regard to the scientific significance of the term "hydrocellulose" has been clearly stated by Hess[10] and the literature has been summarised by Clifford[5] and others.

The work described in this paper is limited to a study of hydrocelluloses which still retain the characteristic structure of the cotton hair, and it is not to be assumed without other evidence that the observed relations can properly be applied to more highly degraded preparations. Damage caused in technical practice by the action of acids upon cotton is generally confined to a partial loss of strength, and the powdery hydrocelluloses obtained by more drastic treatment have therefore received little attention in the present work, though evidently they cannot be so dismissed in any complete scientific study of the subject.

For an examination of the properties of hydrocelluloses which should form the basis of a routine analytical procedure, it was necessary to prepare a large number of cotton samples which had suffered from the attack of acids to different extents and under a variety of conditions. The methods which were originally described by Girard[8] for the preparation of hydrocellulose consisted (i.) in treating cotton with excess of a concentrated mineral acid at ordinary temperatures, (ii.) in submitting cotton to the action of a moist gaseous halogen hydracid, and (iii.) in allowing cotton which carried about its own weight of a dilute mineral acid to "dry" at the ordinary temperature, and subsequently heating it for various times at

40–70° C. Of these, the third method of preparation has frequently been used by later investigators, but the preparative conditions with respect to acid concentration, time, and temperature of treatment, are ill-defined—hence less reproducible—and the concentration of the acid which occurs on the material at an elevated temperature easily results in undesirable and profound cellulose degradation. A wide range of acid-modified celluloses can, on the other hand, readily be obtained under reproducible conditions by the action upon cotton of a large excess of acid at temperatures between 20° and 100° C. The formation of hydrocellulose by the action of heat upon cotton containing relatively small quantities of dilute acid is of practical importance, since damage suffered by cotton in technical processes, when it occurs through the action of acids, is frequently due to this cause, but for a systematic study of the properties of hydrocelluloses, such a method of preparation adds further to the complication of the problem. In this paper many hydrocelluloses are described, prepared both by steeping cotton in excess of acid of different concentrations at temperatures between 20° and 100° C., and by the action of dry heat upon cotton impregnated with small quantities of dilute acid; hydrocellulose formation induced by the former treatment will for convenience be referred to as the result of "acid steeping," and by the latter method as the result of "acid drying."

The fall in the tensile strength of cotton caused by the action of acids under any conditions of treatment is accompanied by a fall in the viscosity of the material when dissolved in cuprammonium hydroxide and by a rise in its reducing power, or copper number. These changes, occurring simultaneously, are not exclusive effects of acid action, since other chemical agents (oxidising agents) are capable of producing the same qualitative changes, but it was considered possible that a measure of the relation between any two quantitative properties of modified cellulose might point the way to a more precise analytical definition of hydrocellulose than any which has yet been given. The first part of this work deals therefore with the inter-correlation of different properties of hydrocellulose.

It is shown that for hydrocelluloses formed under a wide range of different conditions there exists a definite relation between loss of tensile strength and viscosity; in other words, that the same fall of viscosity corresponds to the same loss of strength irrespective of the precise mode of acid tendering. As a guide to the significance of the viscosity measurement, it may be noticed, for example, that acid attack, which causes the viscosity ($\log \eta$) to fall to the value 1, produces a loss of 10% in strength, whilst a loss of 80% in strength corresponds to a viscosity ($\log \eta$) of -1. These figures are taken from measurements of the single-thread breaking load of a standard 40's Egyptian yarn, but within the limits of experimental error they apply equally well to single-hair breaking load. As the strength of yarns depends upon twist and of fabrics upon structure, no general relation can be laid down between viscosity and mechanical tendering, save in a qualitative way, but the present results suffice to establish standards for judging, from measurements of viscosity, the extent of mechanical injury caused by hydrocellulose formation. Since a fall of viscosity to the value 1 caused by the action of acids upon cotton is accompanied by a 10% loss of strength in a particular normal trade product, it cannot be considered over-cautious if, until further information is available, this value of the viscosity is defined as a minimum permissible standard in any cotton materials.

A definite relation also exists between the strength and the copper number of the hydrocelluloses examined, a diminution of 10% in breaking load corresponding to a rise of 0·25 in copper number, and a decrease of 80% in breaking load to a rise of 3·5. Since, however, the copper number is greatly reduced by alkali boiling under conditions which have but little effect upon the viscosity, the latter measurement is more generally useful for the detection and estimation of acid tendering.

From an examination of about seventy different hydrocelluloses prepared by the widest possible range of acid action, it is shown that a given viscosity always corresponds to the same copper number irrespective of the conditions of acid treatment, and the relation between the two quantities can be expressed with reasonable accuracy over the most important range by a simple equation (p. T154). A specific analytical test or definition of hydrocellulose formation is to be found in the rise of copper number relative to the fall of viscosity, which in cases of true hydrocellulose formation conforms with the equation referred to above. By this means it is frequently possible to differentiate sharply between hydrocelluloses and those oxycelluloses which are otherwise indistinguishable from them. The exact relation between the copper number and viscosity of hydrocelluloses appears to vary slightly in comparing modified preparations originating from different samples of cotton. The cause of this variation has not yet been ascertained, but it is not sufficient to confuse the distinction between hydro- and oxycelluloses.

The results so far summarised refer to hydrocelluloses formed by the steeping treatment, but the viscosity-copper number relation has also been shown to hold approximately for hydrocellulose formation by the acid-drying treatment, provided the temperature of heating is not too high (70° C. or below), though the accuracy is here considerably less owing to the inferior uniformity of the material. At higher temperatures reactions occur other than that properly described as hydrocellulose formation, and the observed relation no longer holds.

The action of acids upon cotton is accompanied, in general, by a decrease in its affinity for basic dyes, but exceptions are made by sulphuric and phosphoric acid solutions of high concentration, either under steeping conditions or when the acid is allowed to concentrate upon the material by the action of heat at temperatures above the normal; in both cases there results an increased affinity for basic dyes. These facts have long been recognised qualitatively, and it was recorded by Witz[16] that when cotton fabric is steeped at ordinary temperatures for 20 hours in sulphuric acid containing 670 grams per litre, it dyes a slightly deeper shade with Methylene Blue than the untreated cloth, whilst with sulphuric acid, containing 840 grams per litre, immersion for a few hours results in very deep coloration on subsequent dyeing with the basic dye. Quantitative measurements have been made of the Methylene Blue absorption of many hydrocelluloses formed both by steeping and drying treatments, and it is shown that with sulphuric acid solutions of increasing concentration an initial fall of absorption, which is the normal result of acid action, is followed by a rapid rise when the concentration passes a certain value. The enhanced absorption of Methylene Blue by cotton which has been treated with sulphuric or phosphoric acid was ascribed by Harrison[9] to "a peptised form of hydrocellulose, or an adsorption compound of peptised cellulose with substances of a reducing

character," and similar views have been expressed in the most recent literature (*cf.* Schwalbe[14]). The incorrectness of Harrison's conclusions became probable when Knecht and Thompson[11] showed that the absorbing hydrocelluloses contained sulphuric acid in some unknown combination which could not be broken by boiling with dilute alkalis, though this observation appears to have been overlooked by later writers. The results of the present work fully confirm those of Knecht and Thompson, and in the case of phosphoric acid, where a very convenient analytical method is available, it has been shown that the Methylene Blue absorption is proportional to the acid content of the hydrocellulose. There can now be no doubt but that the enhanced absorption of sulphuric and phosphoric acid hydrocelluloses is due to combined acid which cannot, however, be completely removed by the most drastic alkaline treatments. The most certain analytical method for establishing the existence of damage sustained by cotton materials in technical practice, due specifically to the presence of traces of sulphuric acid during a drying process, would undoubtedly be a micro-determination of sulphuric acid which could compare in simplicity with that available for phosphoric acid. Further examples are given which show how the enhanced absorption due to oxycellulose formation may be distinguished from that due to the action of phosphoric or sulphuric acid, by absorption measurements made from acid Methylene Blue solution (*cf.* previous communication, "The Absorption of Methylene Blue from Buffered Solutions"[4]).

A knowledge of the rate of attack of cotton by acids under various conditions must be considered of equal practical importance with the analytical behaviour of hydrocelluloses, and the second part of this paper is concerned with the quantitative effects of temperature and concentration upon the rate of acid attack. For normal hydrocellulose formation, the copper number can be taken as a true measure of the extent of cellulose degradation, and it is shown that under conditions of acid steeping the increase of copper number with increasing time of treatment is governed by the rule that the copper number is increased by 50% when the time of treatment is doubled. The expression of this rule in the form of an equation enables a constant to be calculated—the velocity constant—which measures quantitatively the rate of attack of any definite acid solution at a definite temperature, and the effect of both acid concentration and temperature upon the velocity constant has been examined in a number of cases. The mean temperature coefficient of hydrocellulose formation over the range 20°–100° C. is found to be 2·3, which means that the copper number resulting from a given acid treatment is increased 2·3-fold by a 10° rise of temperature. With the addition of comparatively few experimental data to this section it would be possible to calculate with considerable accuracy the copper number resulting from the steeping of cotton in hydrochloric or sulphuric acid solution of any concentration for any length of time and at any temperature between 20° and 100° C., and a reasonable approximation can already be made from the recorded figures; since both viscosity and tensile strength have been related to copper number, these quantities could also be calculated.

The addition of neutral salt to a dilute solution of hydrochloric acid is shown to have a very great effect in increasing the rate of acid attack when the salt concentration becomes high, and attention is called to the possible importance of this effect in the action of concentrated zinc or magnesium chloride solutions upon cotton, where high neutral salt concentration is accompanied by slight acidity due to the hydrolysis of the salt.

DETAILED DISCUSSION OF RESULTS

PART I.—PROPERTIES OF HYDROCELLULOSES

I.—Breaking Load and Viscosity

Measurements are recorded in Table I. both of the single thread and the single hair breaking loads of twenty hydrocelluloses prepared by steeping the standard yarn No. 70C in acid, and the relation between these strength measurements and the viscosity of the modified celluloses in cuprammonium solution is shown graphically in Fig. 1. The ordinate scales corresponding to the two curves in the figure have been displaced relatively to each other in order to separate the curves and obtain greater graphical clarity. The conditions under which the individual members of this hydrocellulose series were prepared varied widely, as may be seen from the table, both sulphuric and hydrochloric acids being used in concentrations varying from 0·01*N* to 14*N*, at temperatures of 20° C. and 100° C., and for duration of treatment varying from 0·25 to 48 hours. In spite of this wide range of conditions the viscosity-strength relationship is represented by a single smooth curve within the limits of the experimental errors, and this is the case whether the strength is measured by the single-thread or by the single-hair breaking load.

Table I.

Yarn 70C. Steeped in Acids under various Conditions.

Preparation No.	Acid Treatment				Breaking Load % on Untreated Material		Copper Number N_{Cu}	Log Viscosity in 2% Solution Log η
	Acid	Concentration	Time, hours	Temp. °C.	Single Thread	Single Hair		
36, 44	H_2SO_4	100 g./lit.	48	20	93·3	93·4	0·20	1·33
37, 45	,,	200 ,,	48	20	84·7	80·4	0·42	0·69
38, 46	,,	300 ,,	48	20	70·3	56·3	0·80	0·02
39, 47	,,	400 ,,	48	20	51·4	47·1	1·34	$\bar{1}$·53
40, 48	,,	500 ,,	48	20	34·1	29·9	2·32	$\bar{1}$·23
41, 49	,,	600 ,,	48	20	19·5	17·6	3·48	$\bar{2}$·98
42, 50	,,	700 ,,	48	20	9·7	—	4·36	$\bar{2}$·85
ST, 21	,,	500 ,,	4	20	68·5	72·5	0·66	0·12
ST. 22	,,	500 ,,	12	20	54·5	51·5	1·15	$\bar{1}$·70
ST. 23	,,	500 ,,	24	20	38·5	39·5	1·76	$\bar{1}$·38
CT. 11	HCl	200 ,,	4	20	64·0	58·0	0·85	$\bar{1}$·94
CT. 12	,,	200 ,,	12	20	42·5	42·0	1·46	$\bar{1}$·49
CT. 13	,,	200 ,,	24	20	27·0	30·0	2·44	$\bar{1}$·22
S 17	H_2SO_4	0·01*N*.	0·25	100	92·5	94·0	0·26	1·22
S 18	,,	0·01*N*.	0·5	100	87·5	84·0	0·37	0·82
S 12A	,,	0·01*N*.	1	100	80·7	—	0·52	0·45
S 19	,,	0·01*N*.	2	100	64·5	56·0	0·85	$\bar{1}$·95
S 14	,,	0·1 *N*.	1	100	36·1	—	1·74	$\bar{1}$·37
S 15B	,,	0·2 *N*.	2	100	27·9	—	2·65	$\bar{1}$·17

The variation of viscosity with the breaking load of cotton which has suffered chemical attack by acids has been studied by Farrow and Neale[6] and others, the original contribution offered by this section of the present investigation lying in the proof which it furnishes that the relation between the strength and the viscosity of acid-tendered cotton is independent of the exact mode of tendering within the wide limits described.

The strength of a yarn is dependent not only upon the strength of the hairs which compose it, but also upon the frictional forces between them

and the single-thread breaking load is to this extent a more complex quantity than the single-hair breaking load. It was therefore to be expected that a different relation would exist between viscosity and breaking load for single threads from that obtaining for single hairs, but Fig. 1 shows that *in the particular case examined* such difference is scarcely greater than the experimental errors of breaking load measurement, the two curves being almost coincident when allowance is made for the relative shift in the ordinate scales.

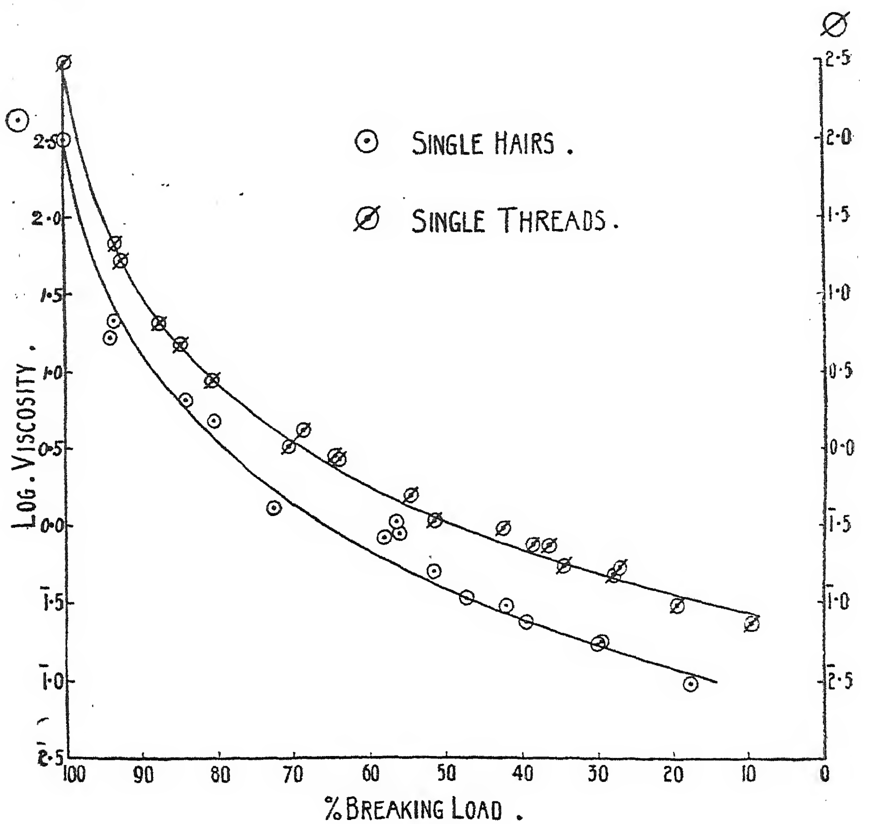

FIG. 1

II.—Breaking Load and Copper Number

The copper numbers of the hydrocelluloses described in Table I. are plotted against single-hair and single-thread breaking loads in Fig. 2, and here again all points lie on or near a smooth curve irrespective of the conditions of hydrocellulose formation. The figure shows that copper number, as a measure of tendering, is most sensitive in the later stages of acid attack where the loss of breaking load is between 50% and 100%, whilst the viscosity (Fig. 1) is most sensitive as a measure of strength changes in the early stages of acid attack which correspond to the first 20% loss in breaking load.

III.—Viscosity and Copper Number

(*a*) *Hydrocelluloses formed by Acid Steeping.*

The copper numbers and viscosities (log η) of a large number of hydrocelluloses prepared from the standard yarn No. 70C are recorded in Table II.

and the values are plotted against each other in Fig. 3 for as many of these preparations as can be represented in one diagram without sacrificing its clarity. The hydrocelluloses described were all prepared by the action of excess of acid (steeping experiments), but under otherwise very diverse conditions of treatment, concentrations varying from 0·05 to 700 grams per litre, temperatures from 20° C. to 100° C., and times of treatment from 0·25 to 960 hours; sulphuric and hydrochloric acids were used for most of the preparations, but results are given for three experiments with acetic

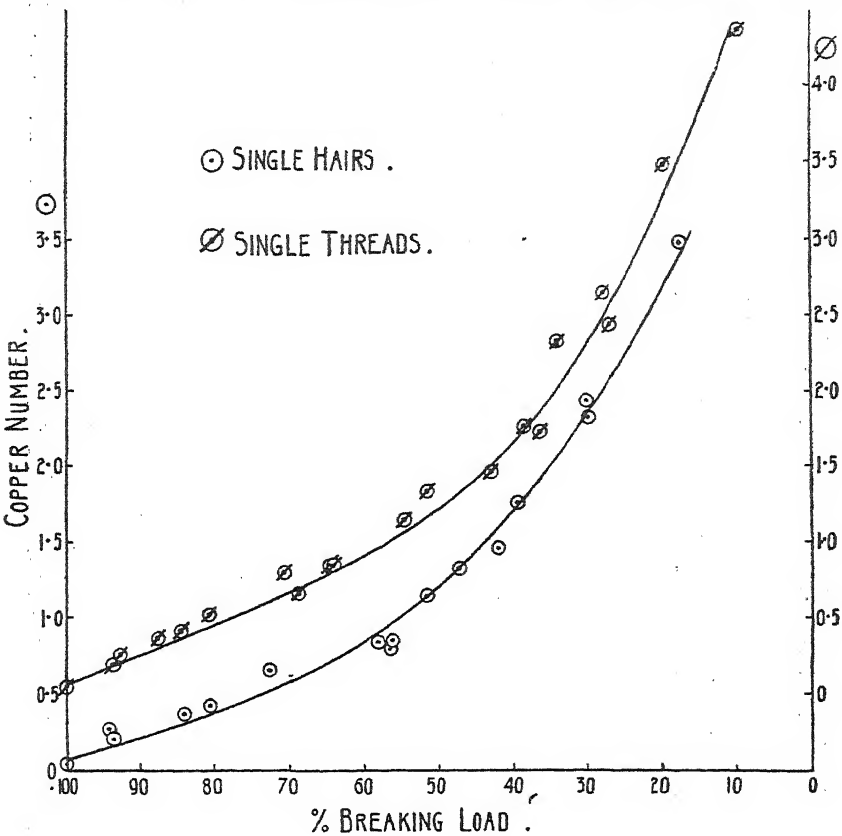

FIG. 2

acid. It can be seen from Fig. 3 that in spite of the wide variation in preparative conditions, all points lie on or near the same smooth curve, a result which can also be expressed by the statement that in this series of acid-tendered cottons a given copper number always corresponds to the same viscosity irrespective of the conditions of acid treatment. The viscosity and copper number are two properties of hydrocelluloses which are susceptible of the most simple and accurate measurement, and the widest range of data has therefore been collected and examined in this section.

The oxidation of cotton cellulose under certain conditions leads to the formation of modified material which resembles hydrocellulose very closely, but for these so-called oxycelluloses the viscosity-copper number relation is very different from that obtained for acid-tendered cottons. The points representing such oxycelluloses in Fig. 3 do not fall upon the curve, and

Table II. Yarn 70C. Steeped in Acids under various Conditions.

Pre-paration No.	Treatment				Copper Number N_{Cu}	Log Viscosity in 2% Solution Log η	Log Relative Viscosity V	$N_{Cu}V^2$
	Acid	Con-centration gms. per litre	Time, hours	Temp. °C.				
A. 1	HAc	6	1	100	0·13	1·74	3·56	1·7
43B.	H_2SO_4	50	48	20	0·15	1·66	3·48	1·9
ST. 11	,,	100	24	20	0·17	1·37	3·19	1·7
S. 5	,,	12·25	24	40	0·20	1·39	3·21	2·1
36 AB.	,,	100	48	20	0·205	1·33	3·15	2·0
S. 11	,,	0·049	1	100	0·22	1·31	3·13	2·2
S. 17	,,	0·49	0·25	100	0·26	1·22	3·04	2·4
C. 13	HCl	0·036	1	100	0·26	1·10	2·92	2·2
A. 2	HAc	60	1	100	0·29	0·83	2·65	2·1
ST. 1B.	H_2SO_4	200	24	20	0·31	0·94	2·76	2·4
ST. 12	,,	100	96	20	0·36	0·77	2·59	2·4
S. 18	,,	0·49	0·5	100	0·37	0·82	2·64	2·6
C. 21	HCl	9·12	24	40	0·385	0·69	2·51	2·4
37 AB.	H_2SO_4	200	48	20	0·42	0·69	2·51	2·7
S. 1	,,	49	20	40	0·45	0·60	2·42	2·6
S. 2	,,	49	24	40	0·46	0·61	2·43	2·7
C. 12	HCl	0·365	1	100	0·495	0·39	2·21	2·4
ST. 13	H_2SO_4	100	192	20	0·52	0·38	2·20	2·5
S. 12A	,,	0·49	1	100	0·52	0·45	2·27	2·7
S. 13	,,	0·98	1	100	0·54	0·28	2·10	2·4
CT. 1	HCl	100	24	20	0·58	0·26	2·08	2·5
ST. 21	H_2SO_4	500	4	20	0·66	0·12	1·94	2·5
ST. 14	,,	100	384	20	0·77	$\bar{1}$·99	1·81	2·5
ST. 2	,,	200	96	20	0·79	0·06	1·88	2·8
38 AB.	,,	300	48	20	0·80	0·02	1·84	2·7
CT. 11	HCl	200	4	20	0·85	$\bar{1}$·94	1·76	2·6
S. 19	H_2SO_4	0·49	2	100	0·855	$\bar{1}$·95	1·77	2·7
C. 14	HCl	0·73	1	100	0·88	$\bar{1}$·87	1·69	2·5
C. 3A	,,	100	48	20	0·91	$\bar{1}$·84	1·66	2·5
A. 4	HAc	60	6	100	0·95	$\bar{1}$·76	1·58	2·4
S. 3	H_2SO_4	100	24	40	1·00	$\bar{1}$·89	1·71	2·9
ST. 3	,,	200	192	20	1·11	$\bar{1}$·74	1·56	2·7
ST. 22	,,	500	12	20	1·15	$\bar{1}$·70	1·52	2·7
C. 22	HCl	36·5	24	40	1·23	$\bar{1}$·65	1·47	2·7
CT. 2	,,	100	96	20	1·28	$\bar{1}$·58	1·40	2·5
ST. 15	H_2SO_4	100	960	20	1·34	$\bar{1}$·62	1·44	2·8
39 AB.	,,	400	48	20	1·34	$\bar{1}$·53	1·32	2·4
CT. 12	HCl	200	12	20	1·46	$\bar{1}$·49	1·31	2·5
ST. 4	H_2SO_4	200	384	20	1·47	$\bar{1}$·52	1·34	2·6
C. 30	HCl	100	5	40	1·52	$\bar{1}$·47	1·29	2·5
C. 28	,,	100	5·5	40	1·54	$\bar{1}$·53	1·35	2·8
45	H_2SO_4	700	6	20	1·64	$\bar{1}$·36	1·18	2·3
ST. 23	,,	500	24	20	1·76	$\bar{1}$·38	1·20	2·5
S. 14	,,	4·9	1	100	1·74	$\bar{1}$·37	1·19	2·5
S. 4A.	,,	200	24	40	1·95	$\bar{1}$·37	1·19	2·8
CT. 3	HCl	100	192	20	1·96	$\bar{1}$·26	1·08	2·3
CT. 13	,,	200	24	20	2·44	$\bar{1}$·22	1·04	2·6
ST. 5	H_2SO_4	200	960	20	2·61	$\bar{1}$·09	0·91	2·2
ST. 24	,,	500	48	20	2·62	$\bar{1}$·17	0·99	2·6
S.15B.	,,	9·8	1	100	2·65	$\bar{1}$·17	0·99	2·6
C. 27	HCl	200	2	40	2·87	$\bar{1}$·13	0·95	2·6
CT. 4	,,	100	384	20	2·94	$\bar{1}$·05	0·87	2·2
S. 7	H_2SO_4	500	4	40	3·12	$\bar{1}$·08	0·90	2·5
C 11	HCl	3·65	1	100	3·17	$\bar{1}$·07	0·89	2·5
41 AB.	H_2SO_4	600	48	20	3·48	$\bar{2}$·98	0·80	2·2
C. 23	HCl	100	24	40	3·67	$\bar{2}$·93	0·75	2·1
S. 16	H_2SO_4	24·5	1	100	4·15	$\bar{2}$·87	0·69	2·0
C. 15	HCl	7·3	1	100	4·22	$\bar{2}$·88	0·70	2·1
42 AB.	H_2SO_4	700	48	20	4·36	$\bar{2}$·85	0·67	2·0
CT. 5	HCl	100	960	20	4·47	$\bar{2}$·83	0·65	1·9
C. 25	,,	200	5	40	4·68	$\bar{2}$·89	0·71	2·4
C. 1	,,	300	48	20	4·70	$\bar{2}$·76	0·58	1·6
S. 6	H_2SO_4	400	24	40	4·75	$\bar{2}$·78	0·60	1·7

a distinction can be drawn between cotton cellulose modified by acids and that modified by the action of oxidising agents. Examples of this will be given later, but a detailed comparison of the viscosity-copper number relation for hydro- and for oxy-celluloses is left to a future communication.

If the relation between copper number and viscosity is to be used as a definition of hydrocellulose formation, or as an analytical test for acid attack of cotton, it must for convenience be expressed in the form of an equation relating the two measurements. Such an equation, which, for practical utility, must combine simplicity and reasonable accuracy, can be

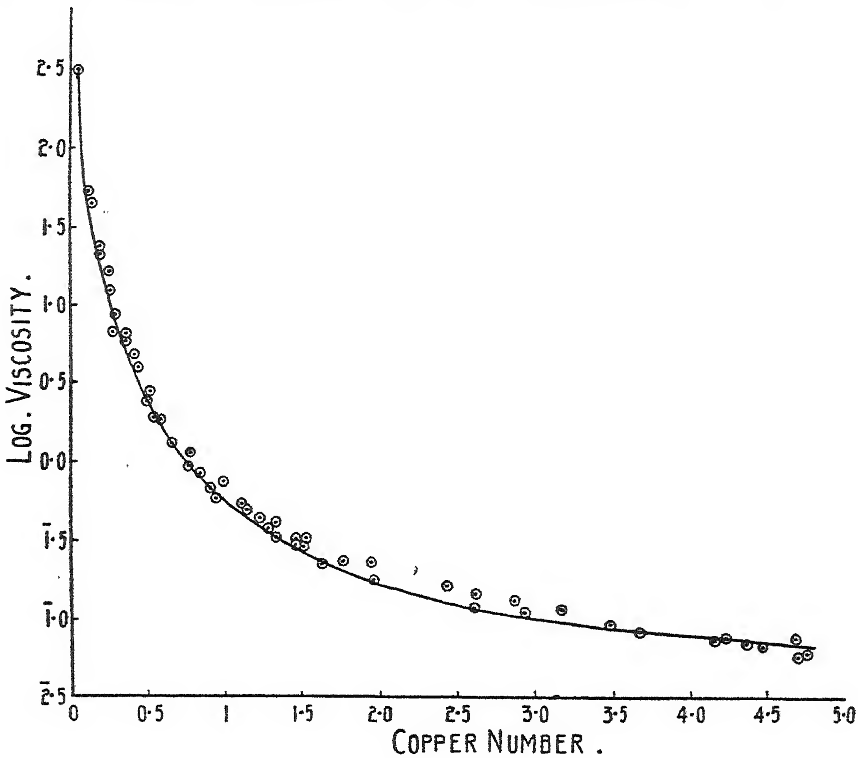

FIG. 3

obtained by a slight alteration in the method of expressing the viscosity measurement. In work from these laboratories the logarithm of the absolute viscosity is the quantity which has hitherto always been employed to characterise modified celluloses, but for the purpose designed above it is found more convenient to use the logarithm of the viscosity of cellulose or modified cellulose *relative to that of the solvent.* If η is the absolute viscosity of a 2% modified cellulose solution, and η_0 is the absolute viscosity of the cuprammonium solvent (taken as 0·0152 poise), then η/η_0 is the relative viscosity of the solution and the quantity log η, generally used in work on modified celluloses, will be replaced by log η/η_0, which will be designated by the symbol V, thus—

$$V = \log \eta/\eta_0 = \log \eta - \log \eta_0 = \log \eta + 1{\cdot}82.$$

In order to obtain V, the logarithm of the relative viscosity, it is only necessary to add 1·82 to the recorded values of the logarithm of the absolute

viscosity ($\log \eta$). If copper number is denoted by the symbol N_{Cu}, then the viscosity-copper number relation for the hydrocelluloses described in Table II. is represented with fair accuracy by the equation—

$$N_{Cu}V^2=2{\cdot}6.$$

In the table the hydrocelluloses are arranged in order of increasing copper number, the product $N_{Cu}V^2$ has been calculated and is recorded for each preparation, and it can be seen that for values of the copper number lying between 0·4 and 3·0, the product is reasonably constant, the mean value for 42 preparations being 2·6. For hydrocelluloses with copper numbers outside these limits the product $N_{Cu}V^2$ becomes less than 2·6, but the range within which the equation is valid is technically the most important and corresponds to loss of tensile strength (breaking load), varying roughly between 15% and 75% that of the untendered material used in this work.

Table III. contains the copper numbers, viscosities, and the product $N_{Cu}V^2$ for a series of oxycelluloses previously described,[2] covering the same range of copper number as the hydrocelluloses of Table II. These were also prepared from the standard yarn No. 70C by the action of hypochlorous acid and by other means could not be distinguished with certainty from hydrocelluloses, but the values of the product $N_{Cu}V^2$ leave no doubt that the modification is in this case not due to acid attack.

A shorter series of experiments has been carried out in which the standard yarn No. 70C was replaced by a standard bleached cloth No. 182, and the results, which are recorded in Table IV., can also be used to illustrate the relation between the viscosity and copper number of hydrocelluloses; some preparations made with phosphoric acid are included in this series.

These acid-treated cloths are also characterised by a sensibly constant value for the product $N_{Cu}V^2$ over a considerable range of copper numbers, the value being, however, somewhat higher than that obtained for the hydrocelluloses of Table II., namely, 2·9 compared with 2·6.

For comparison with these data, Table V. gives the properties of oxycelluloses formed from the cloth No. 182 by the action of hypochlorous and of chromic acids. These oxidised preparations were not distinguishable in individual properties from hydrocelluloses, but it is seen that the product $N_{Cu}V^2$ is not constant and is in all cases much greater than the value obtained for hydrocelluloses. The results, stated in their simplest qualitative form, show that a given copper number produced by the acid attack of cotton is accompanied by a much lower viscosity than when the same copper number results from oxidising attack. This conclusion applies only to oxycelluloses which possess no greatly enhanced Methylene Blue absorption.

(*b*) *Hydrocelluloses formed by Acid Impregnation and Heating.*

Certain inherent difficulties which are encountered in attempting to obtain reproducible results by drying dilute acids upon cotton materials at elevated temperatures render the measured properties of these hydrocelluloses of less intrinsic quantitative value than measurements made on hydrocelluloses formed by steeping cotton in excess of acid. Values are recorded in Table VI. for the copper number and viscosity of preparations obtained from the standard cloth No. 182 by impregnation with dilute acids and subsequent heating under different conditions, the range of copper numbers covered being approximately the same as in the corresponding series of steeping experiments made with this cloth (Table IV.). When the temperature of drying is not above 70° C. the value of the product $N_{Cu}V^2$ is roughly constant

Table III

Yarn 70C. Oxidised with Hypochlorous Acid.

Preparation No.	Copper Number N_{Cu}	Log Viscosity in 2% solution Log η	Log Relative Viscosity V	$N_{Cu}V^2$
YC. 3	0·36	1·37	3·19	3·7
YC. 4	0·55	0·96	2·78	4·2
YC. 5	0·88	0·38	2·20	4·3
YC. 6	1·76	$\bar{1}$·92	1·74	5·3
YC. 7	3·39	$\bar{1}$·44	1·26	5·4

Table IV.

Cloth No. 182. Steeped in Acids under various Conditions.

Preparation No.	Acid Treatment: Acid	Concentration gms. per litre	Time, hours	Temp. °C.	Copper Number N_{Cu}	Log Viscosity in 2% solution Log η	Log Relative Viscosity V	$N_{Cu}V^2$
SC. 37	H_2SO_4	200	48	20	0·495	0·48	2·30	2·6
HCS. 16	HCl	226	1	25	0·70	0·19	2·01	2·8
SC. 38	H_2SO_4	300	48	20	0·94	$\bar{1}$·90	1·72	2·8
PT. 1	H_3PO_4	9·8	1	100	0·97	$\bar{1}$·92	1·74	2·9
HCS. 22	HCl	226	1·75	25	0·99	$\bar{1}$·90	1·72	2·9
HCS. 17	,,	226	2	25	1·09	$\bar{1}$·84	1·66	3·0
HCS. 18	,,	226	3	25	1·37	$\bar{1}$·64	1·46	2·9
PT. 2	H_3PO_4	9·8	2	100	1·43	$\bar{1}$·61	1·43	2·9
SC. 39	H_2SO_4	400	48	20	1·57	$\bar{1}$·54	1·36	2·9
HCS. 19	HCl	226	4	25	1·69	$\bar{1}$·58	1·40	3·3
HCS. 20	,,	226	5	25	1·93	$\bar{1}$·46	1·28	3·1
HCS. 21	,,	226	6	25	2·14	$\bar{1}$·34	1·16	2·9
PT. 3	H_3PO_4	9·8	4	100	2·36	$\bar{1}$·25	1·07	2·7
SC. 40	H_2SO_4	500	48	20	2·64	$\bar{1}$·22	1·04	2·9
PT. 4	H_3PO_4	9·8	8	100	3·12	$\bar{1}$·07	0·89	2·5
							Mean ...	2·9

Table V.

Cloth 182, Oxidised with Hypochlorous Acid and with Chromic Acid.

Preparation No.	Oxidising Agent	Copper Number N_{Cu}	Log Viscosity in 2% solution Log η	Log Relative Viscosity V	$N_{Cu}V^2$
OT. 7	Hypochlorous acid	1·01	0·68	2·50	6·3
OT. 8	,,	1·27	0·62	2·44	7·6
OT. 9	,,	1·70	0·38	2·20	8·2
OT. 10	,,	2·77	0·00	1·82	9·2
CKS. 25	Chromic acid	0·96	0·23	2·05	4·0
CKS. 21	,,	1·33	$\bar{1}$·94	1·76	4·1
CKS. 22	,,	2·10	$\bar{1}$·66	1·48	4·5
CKS. 23	,,	2·90	$\bar{1}$·50	1·32	5·0

and equal to that which characterises hydrocelluloses formed by steeping in excess of acid; much greater constancy cannot be expected in view of the difficulty of obtaining uniformly modified material by this method. There can be no doubt, however, that when the temperature of drying is high, the product $N_{Cu}V^2$ is not constant. The low values resulting from these more drastic treatments probably indicate other changes than the formation of the primary product of cellulose hydrolysis. One such change, which is discussed in a later section, is the combination between cellulose and acid, which results in the formation of hydrocelluloses possessing a high

Methylene Blue absorption. This reaction, super-imposed upon normal hydrocellulose formation, has occurred to a considerable extent in a number of the preparations described in Table VI., particularly those formed at higher temperatures. It is also probable that further cellulose degradation to soluble cellulose dextrins or sugars occurs to an increasing extent with increasing severity of the acid drying treatment. The formation of such soluble reducing products is proved by the fact that the copper numbers of the hydrocelluloses in Table VI., determined without previous washing with water, were from 15% to 50% higher than the recorded values, which were all obtained from washed preparations. The simultaneous occurrence of these reactions is sufficient to explain the complete failure of the viscosity-copper number relation when applied to the preparations obtained by acid impregnation followed by heating at the higher temperatures.

Table VI.

Cloth 182, Impregnated with Acids and Heated under various Conditions.

Preparation No.	Acid Treatment: Acid	Concentration	Time, hours	Temp. °C.	Copper Number N_{Cu}	Log Viscosity in 2% solution Log η	Log Relative Viscosity V	$N_{Cu}V^2$
P. 4	H_3PO_4	0·1*M*	2	50	0·74	0·10	1·92	2·7
H. 8	HCl	0·025*N*	2	50	0·96	$\bar{1}$·77	1·59	2·4
P. 3	H_3PO_4	0·1*M*	2	70	1·23	$\bar{1}$·51	1·33	2·2
A. 13	H_2SO_4	0·025*N*	2	70	1·56	$\bar{1}$·73	1·55	3·7
H. 2	HCl	0·1*N*	2	50	2·06	$\bar{1}$·38	1·20	3·0
A. 17	H_2SO_4	2*N*	0·5	40	2·25	$\bar{1}$·35	1·17	3·1
A. 18	,,	2*N*	1	40	2·49	$\bar{1}$·28	1·10	3·0
H. 9	HCl	0·025*N*	2	70	2·56	$\bar{1}$·14	0·96	2·4
H. 1	,,	0·1*N*	2	70	3·60	$\bar{1}$·06	0·88	2·8
A. 11	H_2SO_4	0·5*N*	2	50	3·79	$\bar{1}$·02	0·84	2·7
							Mean	2·8
P. 1	H_3PO_4	0·1*M*	2	110	1·45	$\bar{1}$·14	0·96	1·3
P. 2	,,	0·1*M*	2	90	1·55	$\bar{1}$·22	1·04	1·7
P. 7	,,	0·1*M*	2	130	1·67	$\bar{2}$·99	0·81	1·1
A. 14	H_2SO_4	0·025*N*	2	90	2·01	$\bar{1}$·34	1·16	2·7
A. 15	,,	0·025*N*	2	110	2·12	$\bar{1}$·15	0·97	2·0
H. 4	HCl	0·1*N*	2	90	2·89	$\bar{2}$·99	0·81	1·9
H. 3	,,	0·1*N*	2	110	3·21	$\bar{1}$·06	0·88	2·5
A. 1	H_2SO_4	0·1*N*	2	110	3·54	$\bar{2}$·91	0·73	1·9

IV.—The Methylene Blue Absorption of Hydrocelluloses

Measurements have been made of the Methylene Blue absorptions of most of the hydrocelluloses, some properties of which have already been tabulated. Absorptions determined in buffered solutions (preceding memoir) will alone be recorded in this paper, but the results are supported by a large number of unrecorded measurements carried out by the original method[1] using unbuffered Methylene Blue solution.

(a) Hydrocelluloses formed by Acid Steeping.

Table VII. records the Methylene Blue absorptions of hydrocelluloses formed by steeping cloth No. 182 in sulphuric acid solutions of increasing concentration for 48 hours at 20° C.

Table VII.

Cloth 182, Steeped in Sulphuric Acid at 20° C. for 48 hours.

Preparation No.	182	SC36	SC37	SC38	SC39	SC40	SC41	SC42
Concentration of H_2SO_4, grams per litre	0	100	200	300	400	500	600	700
Methylene Blue Absorption—								
At *p*H 7	0·89	0·82	0·83	0·82	0·79	0·79	0·94	1·30
At *p*H 2·7	0·31	0·28	0·26	0·25	0·27	0·36	0·72	1·76

Increasing concentration of sulphuric acid causes at first a steady fall in the Methylene Blue absorption of the untreated cloth, but this attains a minimum value at a certain acid concentration beyond which the absorption increases rapidly. The rise begins at a concentration of sulphuric acid from 500 to 600 grams per litre when absorptions are measured with unbuffered or *p*H 7 buffered Methylene Blue solutions, but as described in the previous paper ("Absorption of Methylene Blue from Buffered Solutions"), the effect is greatly enhanced when the dye solutions are acid, and at *p*H 2·7 the rise in the absorption begins at a concentration of sulphuric acid from 400 to 500 grams per litre.

When hydrocelluloses covering a similar copper number or viscosity range to those of Table VII. are prepared by the action of sulphuric acid at considerably higher temperatures, and consequently at much lower concentrations, no rise of absorption is observed, but only the steady fall which characterises the earlier members of the series described above. This is the case for example when cotton is steeped for an hour at 100° C. with sulphuric acid solutions up to a concentration of 0·5*N*, the absorption falling to approximately half that of the untreated material—considerably lower than the minimum values in Table VII., where the initial fall is to some extent masked by the subsequent rise.

The same steady fall of absorption with increasing modification is observed when cotton is steeped in hydrochloric acid *under any conditions*, whether at 20° C. for concentrations up to 300 grams per litre, or at 100° C. for concentrations as high as 0·2*N*. There can be no doubt that a decreasing absorption is the normal accompaniment of the acid attack of cotton, an enhanced absorption being a peculiar property of hydrocelluloses formed by the action of relatively high concentrations of sulphuric or other oxy-acid. The preparations described above, characterised by high Methylene Blue absorption, and formed by steeping cotton at 20° C. in sulphuric acid solutions of concentration greater than 600 grams per litre, were found to contain sulphuric acid which they retained with remarkable tenacity, and it will be shown conclusively in the next section that high absorption is due to this retention of mineral oxy-acid.

(*b*) *Hydrocelluloses formed by Acid Impregnation and Heating.*

Table VIII. gives the Methylene Blue absorptions of hydrocelluloses prepared by impregnating cloth No. 182 with dilute sulphuric acid solutions of various concentrations, and subsequently heating for two hours at four different temperatures. The preparations heated at 50° C. show exactly the same behaviour as the hydrocelluloses of Table VII., prepared by steeping in relatively concentrated acid at 20° C., namely, an initial fall of absorption followed by a rapid rise as the concentration of sulphuric acid increases, this rise beginning at an acid concentration from 0·1*N* to 0·5*N*. At 70° C. the rise is already well marked at an acid concentration of 0·1*N*, whilst at

90° and 110° C. the measurements at *p*H 2·7 show a greatly increased absorption with acid as dilute as 0·025*N*. It will again be observed that the rise of absorption is more sharply defined and relatively much greater in measurements made from the acid (*p*H 2·7) than in those made from the neutral (*p*H 7) Methylene Blue solution.

Table VIII.

Cloth 182, Impregnated with Sulphuric Acid and Heated for two hours.

Temperature of Heating	Concentration of H_2SO_4 :—	0	0·025*N*	0·1*N*	0·5*N*
50° C.	Preparation No.	182	A12	A7	A11
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·65	0·70	1·04
	At *p*H 2·7	0·31	0·28	0·27	1·13
70° C.	Preparation No.	182	A13	A6	A9
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·59	0·98	4·08
	At *p*H 2·7	0·31	0·36	1·36	5·39
90° C.	Preparation No.	182	A14	A5	—
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·66	1·69	—
	At *p*H 2·7	0·31	0·68	1·60	—
110° C.	Preparation No.	182	A15	A20	—
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·67	2·29	—
	At *p*H 2·7	0·31	0·74	2·23	—

Table IX. records the absorptions of hydrocelluloses formed in a similar way by impregnating cloth No. 182 with hydrochloric acid of various concentrations and heating for two hours at a number of different temperatures. The effect of this treatment is in nearly all cases to depress the absorption

Table IX.

Cloth 182, Impregnated with Hydrochloric Acid and Heated for two hours.

Temperature of Heating	Concentration of HCl :—	0	0·025*N*	0·1*N*	*N*
50° C.	Preparation No.	182	H8	H2	—
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·58	0·64	—
	At *p*H 2·7	0·31	0·22	0·26	—
70° C.	Preparation No.	182	H9	H1	—
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·61	0·66	—
	At *p*H 2·7	0·31	0·21	0·23	—
90° C.	Preparation No.	182	H6	H4	H5
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·79	0·55	1·75
	At *p*H 2·7	0·31	0·34(?)	0·24	0·49
110° C.	Preparation No.	182	H7	H3	—
	Methylene Blue Absorption—				
	At *p*H 7	0·89	0·73	0·97	—
	At *p*H 2·7	0·31	0·30	0·43	—

below that of the untreated cloth, though under the most drastic conditions—N acid at 90° C. or 0·1N acid at 110° C.—a definite rise of absorption occurs. This rise is only shown, however, by preparations which have suffered far-reaching degradation, and it differs from that which characterises the sulphuric acid preparations, inasmuch as it is relatively smaller in measurements made from acid than in those made from neutral Methylene Blue solutions.

In order to determine the cause of the high absorption of certain hydrocelluloses, a series was prepared by impregnating and drying cloth with a dilute phosphoric acid solution. For this acid, which is known to cause increased absorption of Methylene Blue similar to that produced by sulphuric acid under the same conditions, a rapid and accurate method of analysis is available (Geake[7]). The Methylene Blue absorptions of hydrocellulose formed by impregnating cloth No. 182 with 0·1M phosphoric acid, and heating for two hours at temperatures between 50° C. and 130° C., are given in Table X., which includes the phosphoric acid content of the preparations after prolonged water washing.

Table X.

Cloth 182, Impregnated with 0·1M Phosphoric Acid and Heated for two hours.

Preparation No.	Temperature of Heating	Methylene Blue Absorption At pH 7	Methylene Blue Absorption At pH 2·7	H_3PO_4 Content M. Moles/100 g.
182	(untreated)	0·89	0·31	0·00
P. 4	50° C.	0·83	0·52	0·35
P. 3	70° C.	0·93	0·71	0·79
P. 2	90° C.	1·39	1·19	1·80
P. 1	110° C.	1·64	1·70	2·62
P. 7	130° C.	1·82	2·14	3·31

It will be seen that, with respect to Methylene Blue absorption, the behaviour of this series of hydrocelluloses is the same as that of similar preparations made with sulphuric acid, the absorption rising with increasing

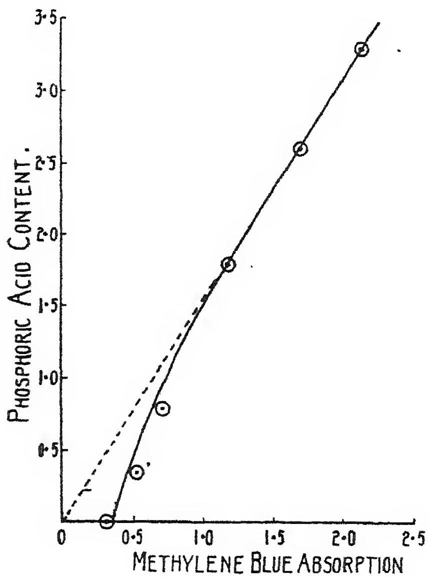

Fig. 4

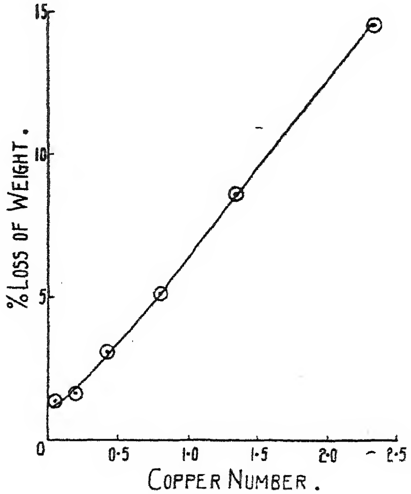

Fig. 5

temperature, more rapidly from acid than from neutral Methylene Blue solution. Associated with this rising absorption is a steady increase in the phosphoric acid content of the preparations, and Fig. 4 shows that the Methylene Blue absorption from solution at *p*H 2·7 is proportional to the phosphoric acid content of the hydrocellulose except in the early stages where this relation is disturbed by the initial absorption of the untreated cotton; the straight line which represents this proportionality in the latter stages passes very close to the origin of co-ordinates and corresponds therefore to a zero absorption when the phosphoric acid content is zero. The results which have been described prove conclusively that when high Methylene Blue absorption results from the action of sulphuric or phosphoric acid upon cotton it is due to the retention of acid and cannot be regarded as a property of hydrocellulose, as this term is defined in an earlier section. Attempts to free the preparations described in Table X. from phosphoric acid, even by the most drastic alkaline treatments, were only partially successful, as shown in the following table.

Table XI.

Phosphoric Acid Hydrocellulose submitted to Hot Alkaline Treatment.

Treatment	H_3PO_4 Content M. Moles/100 g.
Prolonged water washing (P. 7, Table X.)	3·31
Boiled 4 hours with 1% NaOH solution	2·81
,, ,, 5% NaOH solution	2·67
,, ,, 1% KOH in amyl alcohol (b.p. 137° C.) ...	2·86
,, ,, 15% NaOH solution	2·11
Heated in sealed tube at 140° C., 4 hours, with 5% NaOH ...	2·46

V.—Behaviour of Hydrocelluloses on Boiling with Dilute Alkali

It is known that hydrocelluloses are decomposed to a greater or less extent by boiling dilute alkalis, yielding soluble decomposition products, and experiencing therefore a certain loss of weight. Table XII. shows the losses of weight sustained by a series of hydrocelluloses prepared from the yarn No. 70C by steeping in sulphuric acid solutions of various concentrations for 48 hours at 20° C., and it also compares the properties of these hydrocelluloses before and after alkali boiling; for the determination of loss of weight the samples were boiled with 1% sodium hydroxide solution for four hours, but for examining the effect of alkali boiling upon the properties of the hydrocelluloses they were submitted to a technical kier boil of six hours' duration with 1% sodium hydroxide at 20 lbs. excess pressure, a process which produced appreciably greater loss of weight than the analytical procedure.

In Fig. 5 the losses in weight are plotted against copper numbers, and over the range examined the relation is approximately linear, the percentage loss in weight being roughly six times the copper number; this relation is almost the same as that observed for oxycelluloses within the same copper number range,[2] but considerable deviations undoubtedly occur both with hydro- and oxy-celluloses of higher copper number. It is concluded that copper number and loss of weight on alkali boiling have the same analytical significance, but the determination of copper number is greatly to be preferred on grounds of both speed and accuracy. The loss of weight of the untreated material (the "blank") is a very uncertain correction, owing to the indiscriminating nature of the measurement, and is relatively high for slightly modified material.

Table XII.

Sulphuric Acid Hydrocelluloses boiled with Dilute Alkali.

Preparation No.	% Loss of Weight	Copper Number		Log Viscosity in 2% Solution		Single Thread Breaking Load % on Untreated Material	
		Before Boiling	After Boiling	Before Boiling	After Boiling	Before Boiling	After Boiling
70C	1·40	0·04	0·03	2·5	2·03	100	105
36AB	1·69	0·205	0·01	1·33	1·20	93·3	97·8
37AB	3·06	0·425	0·06	0·69	0·40	84·7	84·2
38AB	5·14	0·80	0·08	0·02	$\bar{1}$·91	70·3	67·5
39AB	8·66	1·34	0·21	$\bar{1}$·53	$\bar{1}$·56	51·4	43·0
40AB	14·7	2·32	0·39	$\bar{1}$·23	$\bar{1}$·22	34·1	24·2
41AB	—	3·48	0·56	$\bar{2}$·98	$\bar{1}$·00	19·5	12·1
42AB	—	4·36	0·98	$\bar{2}$·85	$\bar{2}$·85	9·7	5·5

The copper number is in all cases greatly diminished by alkali boiling and would evidently approximate to zero after sufficiently prolonged treatment, but the viscosity is only slightly affected, remaining unchanged for the more highly modified members of the series and suffering a slight fall in the case of the less modified members. The difference of behaviour in this respect is more apparent than real on account of the great sensitiveness of the viscosity to changes in the material in regions of high viscosity.

The effect of alkali boiling upon the single-thread breaking load of hydrocelluloses is not great until the loss of weight becomes considerable, and the less modified preparations suffer no change or actually show an increased strength after kier boiling, due no doubt to swelling of the cellulose and tighter binding of the component hairs in the yarn.

This single series of hydrocelluloses has alone been examined with respect to its behaviour on alkali boiling, but since the copper number-viscosity relation shows that hydrocelluloses prepared under a great variety of other conditions are in nature identical with these, it can be assumed with confidence that they behave in the same way on alkali boiling.

PART II.—RATE OF ACID ATTACK OF COTTON

I.—Copper Number and Time of Treatment

The rates of attack of cotton under two different acid treatments could be compared by means of the copper numbers which result when the two treatments are continued for equal times, but this is not always convenient, since a duration of treatment which produces an intermediate copper number under one set of conditions often produces barely measurable or extremely far-reaching degradation under the other set with which it is to be compared. When the copper number resulting from the action of acid under definite conditions of steeping has been determined for any one time of treatment, it is found possible, however, to calculate the copper number resulting from any other time of treatment within the range of cellulose hydrolysis to which these investigations are restricted. This can be done by means of the rule which is found to hold with fair accuracy that when the time of action of a given acid treatment is doubled, the copper number of the resulting hydrocellulose is increased by 50%; thus, if in one hour a certain acid treatment of cotton results in a copper number of 1, in two hours it produces

Table XIII.

Yarn 70C. Steeped in Acids at 20° C. for various Times.

Acid Solution	Time of Treatment, T :–	0·167	0·5	1	2	4	8	16	40	Days.
H_2SO_4 100 G./Lit.	Preparation No. ...	—	—	ST11	36D	ST12	ST13	ST14	ST15	
	Copper Number, N_{Cu}	—	—	0·17	0·23	0·36	0·52	0·77	1·34	
	Velocity Constant, K	—	—	0·17	0·15	0·16	0·15	0·15	0·15	Mean 0·15
H_2SO_4 200 G./Lit.	Preparation No. ...	—	—	ST1B	37AB	ST2	ST3	ST4	ST5	
	Copper Number, N_{Cu}	—	—	0·31	0·42	0·79	1·11	1·47	2·61	
	Velocity Constant, K	—	—	0·31	0·28	0·34	0·32	0·28	0·29	Mean 0·30
HCl 100 G./Lit. ...	Preparation No. ...	—	—	CT1	C3A	CT2	CT3	CT4	—	
	Copper Number, N_{Cu}	—	—	0·58	0·91	1·28	1·96	2·94	—	
	Velocity Constant, K	—	—	0·58	0·60	0·56	0·56	0·56	—	Mean 0·56
HCl 150 G./Lit. ...	Preparation No. ...	CT20 (i)	—	CT20 (ii)	CT20 (iii)	CT20 (iv)	—	—	—	
	Copper Number, N_{Cu}	0·38	—	1·27	1·83	2·67	—	—	—	
	Velocity Constant, K	1·11	—	1·27	1·21	1·16	—	—	—	Mean 1·19
H_2SO_4 500 G./Lit.	Preparation No. ...	ST21	ST22	ST23	ST24	—	—	—	—	
	Copper Number, N_{Cu}	0·66	1·15	1·76	2·62	—	—	—	—	
	Velocity Constant K	1·94	1·75	1·76	1·73	—	—	—	—	Mean 1·79
HCl 200 G./Lit. ...	Preparation No. ...	CT11	CT12	CT13	C2A	—	—	—	—	
	Copper Number, N_{Cu}	0·85	1·46	2·44	3·06	—	—	—	—	
	Velocity Constant, K	2·48	2·21	2·44	2·02	—	—	—	—	Mean 2·28

Table XIV.

Yarn 70C. Steeped in Hydrochloric Acid, 100 grams per litre, at 40° C.

Time of Treatment, T :—	0·208	0·229	1	Day.
Preparation No. ...	C30 ...	C28 ...	C23	
Copper Number, N_{Cu} ...	1·52 ...	1·54 ...	3·67	
Velocity Constant, K ...	3·90 ...	3·73 ...	3·67	Mean 3·77

Table XV.

Yarn 70C. Steeped in 0·01N Sulphuric Acid at 100° C.

Time of Treatment, T:—	0·0104	0·0208	0·0417	0·0833	Day.
Preparation No. ...	S17	S18	S12A	S19	
Copper Number, N_{Cu} ...	0·26	0·37	0·52	0·85	
Velocity Constant, K ...	4·05	3·77	3·50	3·79	Mean 3·78

a copper number of 1·5 and not of 2 as would be the case if the copper number were proportional to the time of action. This relation between copper number and time of acid action is closely expressed by the equation—

$$N_{\mathrm{Cu}}=KT^{0\cdot 6}$$

where N_{Cu} symbolises copper number, T the time of treatment, K being a constant under definite conditions of acid treatment (concentration, temperature). In view of the empirical nature of the copper number measurement, no theoretical significance can be attached to the form of this relation. If the time is measured in days the constant of the equation gives directly the copper number which results from the acid treatment continued for one day. When the copper number which corresponds to any time of treatment is known, substitution of the values in the equation enables K, the copper number after one day's treatment, to be calculated directly, and the test of the accuracy of the above equation is to be found in the agreement between the values of K obtained by substituting a number of different values of the time T, and of the corresponding copper numbers N_{Cu}. This test has been applied to the data given in Tables XIII., XIV. and XV., which record the rate of change in copper number of the standard yarn No. 70C when steeped in sulphuric or hydrochloric acid solutions of various concentrations and at different temperatures, and it will be seen that the value of K is sensibly constant for each set of conditions.

The mean value of K derived from a series of experiments covering a range of copper numbers, as illustrated in the tables, is the best measure of the rate of attack of a given acid solution under definite conditions of concentration and temperature. For the calculation of this constant, which will be called the velocity constant, values of the copper number above 4 have not been used, since such values approach the upper limit set by the routine analytical method employed.

II.—Effect of Concentration of Acid upon Rate of Attack of Cotton

The rate of attack of cotton, measured by the velocity constant, is given in Table XVI. for hydrochloric and sulphuric acids over a range of concentrations at three different temperatures. The velocity constants have been calculated from single observations in a number of cases, whilst in others they have been directly determined as the copper number resulting from one day's acid treatment, neither procedure being as accurate as that described in the last paragraph, where the constant is evaluated from a series of observations.

Table XVI.

Yarn 70C. Steeped in Acids of Various Molar Concentrations.

Temperature		Sulphuric Acid.							
20° C.	Concn. of Acid	0·51	1·02	2·04	3·06	4·08	5·10	6·12	7·14
	Velocity Constant, K	0·10	0·15	0·30	0·53	0·88	1·79	2·30	3·77
40° C.	Concn. of Acid	0·125	0·50	1·02	2·04	5·10	—	—	—
	Velocity Constant K	0·20	0·50	1·00	1·95	9·1	—	—	—
100° C.	Concn. of Acid	0·0005	0·005	0·05	0·10	—	—	—	—
	Velocity Constant K	1·48	3·78	11·7	17·9	—	—	—	—

		Hydrochloric Acid.				
20° C.	Concn. of Acid	2·74	4·11	4·94	5·48	8·22
	Velocity Constant K	0·56	1·19	1·65	2·28	6·50
40° C.	Concn. of Acid	0·25	1·0	2·74	5·48	—
	Velocity Constant K	0·39	1·23	3·77	12·8	—
100° C.	Concn. of Acid	0·001	0·01	0·02	0·10	—
	Velocity Constant K	1·74	3·33	5·92	21·3	—

For the purpose of comparing the activities of the two acids with respect to rate of hydrocellulose formation, concentrations are expressed in molarities, and in Fig. 6 the rate of acid attack of cotton at 20° C. is plotted against concentration of hydrochloric or sulphuric acid; in Figs. 7 and 8, similar curves are given for both acids at 40° C. and 100° C. respectively. These curves show that at any temperature the rate of hydrocellulose formation is approximately the same for solutions of the two acids of equal molar concentration (not equivalent solutions), hydrochloric acid being, however, always slightly more active than sulphuric acid. The velocity constant at 20° C. and 40° C. is almost proportional to the acid concentration for values below 3 molar, but for increasingly rising concentrations above this value the curves become increasingly steeper, as shown in Figs. 6 and 7, that is,

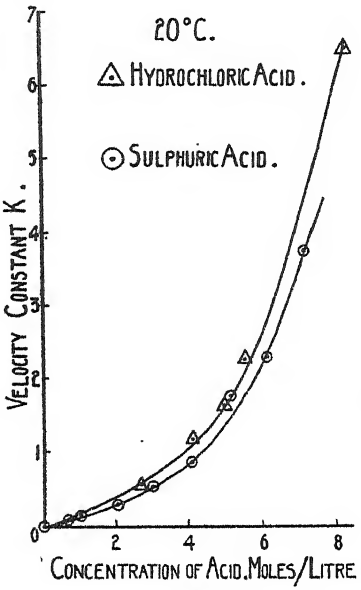

Fig. 6

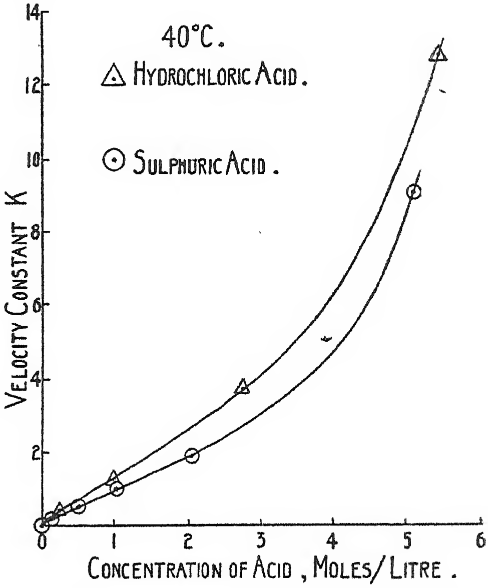

Fig. 7

the rate of attack increases much more rapidly than the acid concentration; thus the activity of 8-molar hydrochloric acid at 20° C. is nearly six times that of 4-molar acid. It is not possible to examine the shape of the curves at 100° C. for such high acid concentrations, since the velocity constant at this temperature would be of the order of several hundreds, and the rate of attack would thus be too rapid for accurate measurement.

III.—Effect of Temperature upon the Rate of Acid Attack

The temperature coefficient of the rate of hydrocellulose formation as measured by copper number can be calculated from the velocity constants already recorded over the temperature range 20° C. to 40° C. for sulphuric acid at concentrations of 0·5*M*., 1·02*M*., and 2·04*M*., and for hydrochloric acid at a concentration of 2·74*M*., the values being 2·2, 2·5, 2·4, 2·5 respectively for a 10° interval. The coefficient can also be calculated, though with less accuracy, over the higher temperature ranges 60° C. to 100° C. for 0·1*M* hydrochloric acid (using a determination of the velocity constant at 60° C. given in the next section), and 40° C. to 100° C. for 0·1*M* sulphuric acid; the result is 2·2 in both cases. The average value obtained is thus 2·3,

which means that the copper number resulting from the action of a given solution of either acid acting for a definite time is increased approximately 2·3 fold by a 10° rise of temperature within the range 20° C. to 100° C.

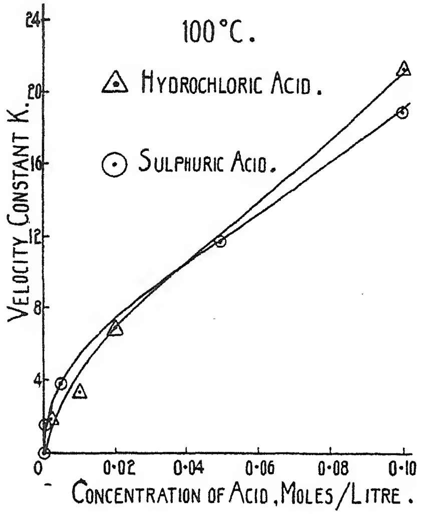

Fig. 8

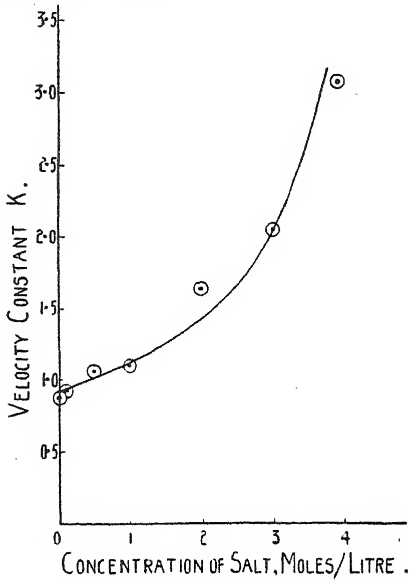

Fig. 9

IV.—Effect of Neutral Salt upon Rate of Acid Attack

It has been found that high concentrations of sodium chloride very greatly increase the activity of hydrochloric acid, and Table XVII. records the velocity constants for the action of 0·1*M* hydrochloric acid at 60° C. upon the yarn No. 70C in the presence of increasing concentrations of sodium chloride.

Table XVII.

Effect of Sodium Chloride upon Rate of Attack of Yarn 70C. by 0·1*M* HCl at 60° C.

Concn. of NaCl ...	0	0·1	0·5	1	2	3	3·9 Molar
Velocity Constant K	0·87	0·92	1·06	1·10	1·63	2·04	3·05

A very great effect is observed, the rate of attack of the dilute acid being increased over threefold by making the solution 3·9*M* in sodium chloride (roughly three-quarters saturated). In Fig. 9 the velocity constant is plotted against the salt concentration, and the resulting curve is similar in shape to those of Fig. 6, the rate of attack at high salt concentrations increasing much more rapidly than the concentration of the salt. It seems probable that these observations have an important bearing upon the action of concentrated solutions of zinc or magnesium chloride upon cotton. The acidity of these solutions, which is a consequence of the hydrolysis of the salt, is not considerable, but its effect may be greatly enhanced by the high concentration of neutral salt.

V.—Rate of Attack when Cotton is Impregnated with Dilute Acid and Heated

The rate of attack of cotton materials which contain dilute acid on drying at elevated temperatures is not capable of very systematic treatment owing to variations in the acid concentration which necessarily occur during the process, but qualitatively, at least, the progress of acid attack is very

different from that which distinguishes hydrocellulose formation by excess of acid of constant concentration.

Table XVIII. records the copper numbers which result when cloth No. 182 is impregnated with three different acid solutions and heated at constant temperature for various times. It is remarkable that with both sulphuric and phosphoric acids, after a short period, continued heating produces only a very slow rise of copper number, and it has also been observed that the fall of viscosity is very slow after the initial effect. The rise of copper number caused by doubling the time of treatment does not exceed 10%, and in most cases is very much less, whilst it will be remembered that in the acid steeping experiments the effect of doubling the time of treatment was to increase the copper number by 50%. Since the acids are not appreciably volatile at temperatures up to 110° C., the conclusion appears unavoidable that acid is *consumed* in reactions other than true hydrocellulose formation.

Table XVIII.

Cloth 182, Impregnated with Dilute Acids and Heated for various Times.

Concn. of Acid	Temperature of Heating	Time of Heating :—	0·33	0·5	1	2	4 hours
H_2SO_4 2N	40° C.	Preparation No.	—	A17	A18	—	—
		Copper Number	—	2·25	2·49	—	—
H_2SO_4 0·5N	70° C.	Preparation No.	A16	A10	—	A9	—
		Copper Number	4·26	4·49	—	4·57	—
H_3PO_4 0·1M	110° C.	Preparation No.	—	P8a	P8b	P8c	P8d
		Copper Number	—	1·28	1·34	1·46	1·52

Similar conclusions must be drawn from an examination of the temperature effect, and Table XIX. records the copper numbers of hydrocelluloses formed by the impregnation of cloth No. 182 with dilute sulphuric and phosphoric acids, with subsequent heating for two hours at temperatures ranging from 50° C. to 130° C. With increasing temperature the copper number rises to a maximum, and beyond this point temperature has little or no effect upon the copper number, behaviour very different from that observed in the steeping experiments where a rise of 10° C. increased the copper number 2·3-fold. It has been observed that the viscosity continues to fall slowly with rising temperature, so that the product $N_{Cu}V^2$ also falls, an effect which has already been noted and which is well exemplified by the phosphoric acid preparations already described in detail in Table VI.

Table XIX.

Cloth 182, Impregnated with Dilute Acids and Heated for 2 Hours at various Temperatures.

Concn. of Acid	Temperature of Heating :—	50°	70°	80°	90°	110°	130° C.
H_2SO_4 0·5N	Preparation No. ...	A11	A9	—	—	—	—
	Copper Number ...	3·79	4·57	—	—	—	—
H_2SO_4 0·1N	Preparation No. ...	A7	A6	A19	A5	A1	—
	Copper Number ...	1·60	3·65	3·21	3·44	3·54	—
H_2SO_4 0·025N	Preparation No. ...	A12	A13	—	A14	A15	—
	Copper Number ...	0·30	1·56	—	2·01	2·12	—
H_3PO_4 0·1M	Preparation No. ...	P4	P3	—	P2	P1	P7
	Copper Number ...	0·74	1·23	—	1·55	1·45	1·67

There is thus considerable evidence that hydrocellulose formation by the method under discussion is accompanied at the higher temperatures by other reactions which result in an actual consumption of acid, and which, like all other cellulose degradations, are accompanied by falling viscosity without, however, any great change of copper number. One such reaction is, no doubt, that fixation of sulphuric or phosphoric acid which subsequently produces hydrocelluloses with an enhanced Methylene Blue absorption.

Hydrochloric acid occupies a unique position in this series of experiments on account of its volatility, the normal increase of rate of attack with temperature being counterbalanced by the rapidly increasing volatility of the acid. The result of these conditions is that the copper number of cotton impregnated with dilute hydrochloric acid and heated increases at first with rising temperature, passes through a maximum, and then falls again as the temperature and volatility of the acid become high. From Table XX. it will be seen that the maximum copper number is reached at about 70° C. both with 0·1*N* and 0·025*N* hydrochloric acid, and a solution of the latter concentration can be heated in contact with cotton at 90° C. without producing significant tendering, whilst the same acid at 70° C. causes loss of strength of the order of 70%.

Table XX.

Cloth 182, Impregnated with Hydrochloric Acid and Heated for 2 hours.

Concn. of Acid	Temperature of Heating :—	50°	70°	90°	110° C.
HCl	Preparation No. ...	H2 ...	H1 ...	H4 ...	H3
0·1*N*	Copper Number ...	2·06 ...	3·60 ...	2·89 ...	3·21
HCl	Preparation No. ...	H8 ...	H9 ...	H6 ...	H7
0·025*N*	Copper Number ...	0·96 ...	2·56 ...	0·10 ...	0·20

EXPERIMENTAL METHODS

(A) Preparation of Hydrocelluloses

(i.) *Steeping in Acid at* 20° *C. and* 40° *C.*—Cotton was added to the acid in a thermostat in the proportion of 40 grams of the former to 1 litre of the latter, care being taken to ensure thorough wetting. The concentration of acid was usually controlled by titration against standard sodium hydroxide, but in some cases the more concentrated solutions were made up to the required specific gravity. After removal from the acid the hydrocellulose was washed with distilled water and air-dried, but when concentrated sulphuric acid solutions were used, the hydrocellulose was dipped in a diluter solution before washing with water, in order to avoid any appreciable rise of temperature.

For the measurement of yarn and hair breaking loads, special precautions were necessary in sampling the material, and the following "cut-skein" method was therefore adopted (Midgley and Peirce[13]). Two leas of yarn were wound from a hank and cut at the two ends of a diameter, being first tied with string at each side of the cuts in order to prevent untwisting; one half of the two leas was treated with acid and the other retained as a control. From the remainder of the hank two bundles of threads of about three inches length were obtained by cutting through the skein, and 1,000 normal hairs were taken from one of these by carefully untwisting 100 threads and selecting ten hairs from each. These hairs were submitted to the acid treatment together with the yarn, and from the remaining three-inch bundle of threads hairs were taken in the same way and preserved as

controls. The portion of the hank still remaining, and further hanks as might be necessary, were treated and used for the various chemical tests.

Treated hairs were thoroughly washed on a filter plate with distilled water and immersed overnight in water to which a drop of dilute ammonia solution was added; they were then again washed, pressed between filter paper, and air-dried. The adequate removal of acid from treated yarn or cloth necessitated, however, more prolonged washing, and although a nearly neutral wash-water could soon be obtained, this offered no guarantee that acid had been eliminated from the interior of the material. The following washing method was finally adopted for hydrocelluloses prepared from yarns or fabrics. The preparation after removal from the acid was washed once or twice by decantation with distilled water and centrifuged in a "hydro-extractor" running at 2,000 r.p.m. and having an ebonite basket of $5\frac{3}{4}$ inches diameter, the water content being thus reduced to about 100% of the dry weight of the material. It was then washed in the hydro-extractor twelve times to complete the removal of surface acid, and steeped in 25 times its weight of distilled water. After standing a day the wash water was tested, the hydrocellulose centrifuged, washed three times in the hydro-extractor, and again steeped. This process was repeated until, for three days in succession, the water after steeping was not more than $10^{-5}N$ in mineral acid, and the hydrocellulose was then dried by exposure to the air at room temperature. The wash waters were tested with Methyl Red (*p*H 4·2 to 6·3), and occasionally by measurement of electrical conductivity, the following figures, which were obtained after treatment of a 40's yarn with sulphuric acid at 700 grams per litre, being given to illustrate the progress of washing.

Time after removal from acid	1 hr.	3 hrs.	1 day	2	4	5	6	7	8 days
No. of wash water ...		First		2nd	3rd	4th	5th	6th	7th
Specific conductivity in reciprocal ohms ...	7·2	13·3	29·3	9·4	12·4	12·0	5·7	6·4	5·0

The final figures correspond approximately with the conductivity of $10^{-5}N$ sulphuric acid.

This process did not eliminate the acid completely, and a number of determinations of sulphuric or hydrochloric acid in normal hydrocelluloses possessing no enhanced Methylene Blue absorption gave results varying between 0·03 and 0·2 milli-equivalents per 100 grams. These small quantities of acid were insufficient to cause damage during short storage, and the figures given below illustrate the stability of a preparation washed in the manner described.

	Copper Number	Log Viscosity
Hydrocellulose No. S.T. 5—Freshly prepared	2·61	$\bar{1}$·09
,, ,, After storage for 12 months ...	2·64	$\bar{1}$·07

(ii.) *Boiling with Acid*—Cotton was boiled with about 50 times its weight of standard acid under the reflux condenser with occasional shaking. All the solutions used were too dilute to have boiling points appreciably different from that of pure water. When $0{\cdot}001N$ acids were employed it was essential to reduce the ash alkalinity of the cotton by shaking for an hour at room temperature with $0{\cdot}1N$ sulphuric acid and washing to neutrality, since otherwise the acid was completely neutralised during the boiling. Hairs for the measurement of breaking load were boiled at the same time in a separate small flask.

(iii.) *Impregnating with Acid and Heating*—Considerable difficulty was encountered in obtaining significant measurements of the properties of hydrocelluloses formed by impregnating cotton with dilute acid solutions, drying, and heating the material at an elevated temperature. This difficulty arose from the fact that the acid attack did not occur uniformly over or through the material, and the correlation of measurements made on different samples from the same preparation was for this reason of uncertain value. The following method was finally adopted: Cotton in the form of cloth was thoroughly wetted out in a large volume of the acid and repeatedly mangled between rubber rollers until the weight was double the air-dry weight ($2\frac{1}{4}$ times in the case of phosphoric acid solutions); it was then allowed to "dry" overnight in the air and heated on a rotating glass frame inside an electric oven maintained at the required temperature for the necessary length of time. This procedure yielded reasonably uniform and reproducible results when the concentration of acid was not less than 0·025*N*, but with acid as dilute as 0·01*N* no method was found which yielded uniform results over a considerable area of cloth. The cotton was in all cases washed with cold dilute acid and water before impregnation and heating, in order to reduce the ash alkalinity to as low a value as possible, but even after this treatment the residual ash alkalinity varied from 0·5 to 1 milli-equivalent per 100 grams, and when 0·01*N* acid solutions were used the amount of acid present on the cloth (1 milli-equivalent per 100 grams) was thus of the same order of magnitude as the residual ash alkalinity. The irregular results which were obtained with very dilute acids can only be ascribed to irregular distribution of the residual ash with consequent partial and non-uniform neutralisation of the acid by it.

The washing process which followed the acid treatment was somewhat less rigorous than that described above, and some measurements of copper number were also made on the unwashed material.

(B) Methods of Measurement

(i.) *Breaking Load*—A number of measurements made on samples prepared in the course of this work have been published recently by Vincent[15] and these are utilised here. Additional determinations of yarn-breaking loads were made on a Goodbrand Single Thread Tester, using 40 cm. lengths and at a constant temperature of 20° C., and relative humidity of 70%. Each hydrocellulose was compared with the corresponding control sample obtained as already described, the individual controls from the same batch of hanks differing considerably from one another in mean breaking load. Single threads of the tendered and untendered control samples were examined alternately, 150 breaks being observed on each, and this number was sufficient to reduce the probable error to a small value.

Hair-breaking loads were measured with an improved O'Neill apparatus[12] at a constant temperature of 20° C. and relative humidity of 66·3%, 200 breaks being observed on each tendered and control sample. All hydrocellulose breaking loads are expressed as percentages on those of the untreated control specimens.

(ii.) *Copper Number*—Braidy's method was used, the details being as recently described.[3] Samples weighing 2·5 grams were taken for analysis and results are expressed as grams of copper reduced per 100 grams of dry material. Good agreement was obtained between duplicates, except when the copper number was very high.

(iii.) *Viscosity*—The viscosity of hydrocelluloses in cuprammonium solution was estimated by the method of Farrow and Neale.[6] Results are recorded for 2% solutions, and when the viscosity was very high these values were calculated from measurements made in weaker solutions, as described in the paper referred to above.

(iv.) *Methylene Blue Absorption*—This was measured on 2·5 gram samples by the titrimetric method already described, using buffered Methylene Blue solutions of *p*H 7, and in some cases acetic acid solutions of *p*H 2·7[1,4]. The results are expressed as millimols of Methylene Blue absorbed per 100 grams dry material.

(v.) *Loss of Weight on Alkali Boiling*—The procedure described by Birtwell, Clibbens, and Ridge[2] was adopted.

(vi.) *Phosphorus Content*—This was determined by the method already described.[7] In order to avoid loss of phosphoric acid by volatilisation, the sample for analysis was moistened with dilute sodium carbonate solution before ignition.

(C) Material Used

With a few exceptions, the hydrocelluloses formed by the acid steeping process were prepared from a 40's combed Sakel warp yarn (No. 70C), spun with standard twist, which had been technically scoured with 1% sodium hydroxide solution for six hours at 20 lb. excess pressure.

Hydrocelluloses formed by acid drying and a few by acid steeping were prepared from a cloth of American cotton (No. 182) which had been scoured for eight hours with 1% sodium hydroxide at 40 lb. excess pressure and lightly chemicked.

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16—THE COTTED FLEECE

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INTRODUCTION

During the last three years the writer has been engaged on a study of the fleece of the Welsh Mountain sheep in connection with a scheme of wool improvement put forward by the University College of North Wales, Bangor, and carried out in conjunction with the Animal Breeding Research Department, University of Edinburgh. His attention was particularly directed to the problem of the cotted fleece by Mr. King and Mr. Frobisher, of the British Research Association for the Woollen and Worsted Industries, and the samples collected from the Welsh Mountain pedigree sheep of the College flock appeared to provide suitable material for a study of the condition.

MATERIAL

The "cotted" fleece in its extreme form is well known to those who deal with wool in its raw state. The cotted fleece is closely matted together usually fairly near the skin, and considerable force has to be exerted in order to tear it apart; the writer is informed that such fleeces are sometimes so closely matted that they can be used as rugs. A badly cotted fleece is definitely much less valuable than a similar normal fleece. The examination of numerous samples soon showed that there is often a tendency for the same matting to occur in a much less severe form, and that in fact it is possible to obtain a complete series ranging from fleeces that are heavily cotted down to fleeces that show just the faintest indication of a line of cotting when a staple is spread out. Only the very heavily cotted fleece would be described as such in the trade sense, but a study of the lightly matted variety is of value in determining the nature of the process involved and also in determining the possible causes that lead up to the condition. In 1920, 1923, 1924, and 1925, 246 samples were available, taken at shearing time from the pedigree Welsh Mountain sheep mentioned. In 181 cases there was no indication of cotting; in 65 cases there was at least some trace of it. For the sake of convenience it was necessary to form some estimate of the severity of the cotting in any particular case. The 65 samples (nearly all taken from the shoulder) were accordingly arranged in order of severity of cotting as far as this could be judged by eye and feel. The samples were then classified into grades, Grade 1 representing the most heavily cotted condition, Grade 5 the least. It is probable that only those fleeces placed in Grade 1 would be technically described as cotted; in 1924, Mr. James Briggs, who graded the pedigree wool, classed five fleeces as cotted, and it was found after the above classification had been effected that these five fleeces had all been placed in Grade 1 and that no other fleece of the 1924 clip had been placed in that grade. The Plates I. to IV. show samples of various cotted fleeces, and in each case the grade of cotting is noted. The cotting may be exhibited right at the bottom of the staple, as shown in Plate II., Fig. 2, or may be as high as that shown in Plate II., Fig. 1. It is also an important point that in none of the 65 cases examined did cotting occur twice during the year.

THE NATURE OF THE PROCESS THAT RESULTS IN COTTING

The examination of samples of cotted fleeces has led to the conclusion that the formation of the matted area is due to the shedding from their follicles of a proportion of the wool fibres. If all, or nearly all, the fibres are shed, the fleece is, of course, shed as a whole, as is sometimes seen. If, however, it is only a proportion that is shed, continuity is maintained. Before the shedding actually takes place the fibre becomes considerably reduced in diameter; this thin terminal portion which is extremely convoluted becomes intertwined round the similar convoluted terminal portions

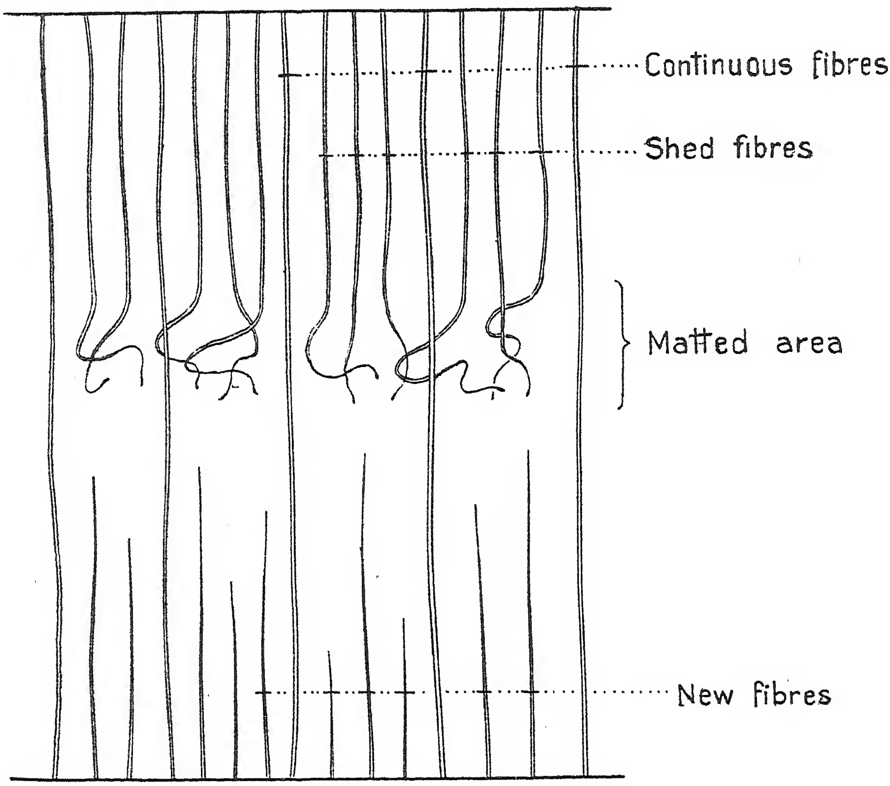


FIG. 1

of other shed fibres, and so the mat is produced. Later new fibres appear and it is difficult to determine whether or not their fine whip-lash tips also become involved in the network; probably they do not to any extent, but the point is of little practical importance, as it does not affect the main contention that cotting is due to a partial shedding of the fibres composing the fleece. The matted area is often particularly rich in wool grease, but its removal by means of ether does not destroy the mat. There may or may not be a certain amount of loosening after this treatment—the point is difficult to determine simply by inspection and handling—but the fact undoubtedly remains that any effect of the increased production of wool grease in binding the fleece together at the cotted line, if it exists at all, is subsidiary to the actual intertwining of the fibres. The text-figure indicates diagrammatically

the nature of the process. The evidence on which the above conclusion is based will now be presented—

1—The great majority of samples from cotted fleeces show a difference in density, *i.e.* in the number of fibres above and below the cotted line, the area proximal to the cotted line being definitely less dense than that distal to it. This can only mean that a proportion of the fibres terminate in the cotted area. If a fair proportion of the staple is proximal to the cotted line, it is seen that there is a gradual increase in density in the proximal direction; again, this can only mean that a new growth of fibres is taking place. The samples shown in the plates illustrate these points very well; it is most clearly seen in those cases where the severity of the cotting is moderate, but even in the sample shown in Plate I., Fig. 2, which exhibits the highest grade of cotting, the same situation can be made out. Plate IV., Fig. 1, is specially instructive; in the case of this sheep most of the fleece had been shed in patches before shearing and in the sample photographed continuity is only maintained by a small proportion of fibres.

2—Attempts to dissect cotted samples confirm the above conclusion. Fibres that are continuous throughout the length of the staple can easily be pulled out. They are not tangled in the mat and they provide the basis for continuity; but for this, the fleece would, of course, be shed as a whole. If the bottom of the staple below the cotted line is firmly clamped down it should be possible to pull out fibres terminating in the cotted area which would show the little terminal bulb that indicates that shedding has taken place. In practice this is not easy, owing to the fragile nature of the terminal portions and to the fact that they are involved in the network; however, it has been found that with care fibres can be pulled out in this way which actually show the little terminal bulb when examined under the microscope. Similarly, if the sample is clamped down above the cotted area, the tips of new fibres, complete with whip-lash ends, can be pulled out.

There is no reason to doubt that cotting of whatever grade of severity depends essentially on the same process. A complete range without discontinuity anywhere can be obtained, and also, as mentioned above, the process can be traced directly even in such a heavily cotted fleece as that shown in Plate I., Fig. 2. There need therefore be little hesitation about the applicability of observations made on the more lightly cotted samples to those which would be termed cotted in the trade sense.

THE TIME OF YEAR AT WHICH THIS PROCESS OCCURS

Certain preliminary work carried out by the writer would seem to show that the rate of growth of the fleece is remarkably uniform. This observation makes it possible to arrive at an estimate of the time of year at which cotting occurs by an examination of samples taken at shearing time. Work on these lines is being carried out at present, and is in much too elementary a stage for any definite conclusions to be stated, but as long as it is realised that the assumption of a uniform growth-rate is tentative, it is useful to attempt to discover whether the cotting process tends to occur at any particular period and to determine the limits of that period. For this purpose the length of each sample (only those taken from the same point, the shoulder, were considered) was measured, together with the distance from the cotted line to the tip of the staple and to the bottom of the staple. Assuming, therefore, a uniform growth rate and allowing one centimetre for the length

of the wool left on the sheep, and knowing the dates of shearing, a percentage value was calculated as follows—

$$\frac{(\text{Length from cotted line to bottom of staple}) + 1{\cdot}0 \text{ cm.}}{\text{Total length of staple}} \times 100$$

As the dates of shearing were practically identical in the years considered, the total length of the staple represents a year's growth, 8·3% of the total representing a month's growth. If, for example, the result of the calculation above were 25%, it would indicate that the process occurred three months before the date of shearing. Of course, this method is only applicable in the case of shearings after the first. The results of an examination of 48 samples were as follows—

Table I.

Month during which process occurred	No. of cases
November	1
December	3
January	9
February	26
March	6
April	3

It should be noted that there are possible sources of error, as already indicated, which might result in this estimate giving rather too early or too late a period as the critical one. In addition, there are a few sources of error that might affect individual values, *e.g.* a few sheep might have been trimmed for show or in the case of a fleece that was nearly shed the attenuated portion of the staple would tend to be stretched out, but these individual errors are not likely to be important.

The data can also be examined with reference to another important point, viz., whether the critical period occurs at different times in different seasons. The results for the years 1923, 1924, and 1925 are as follows—

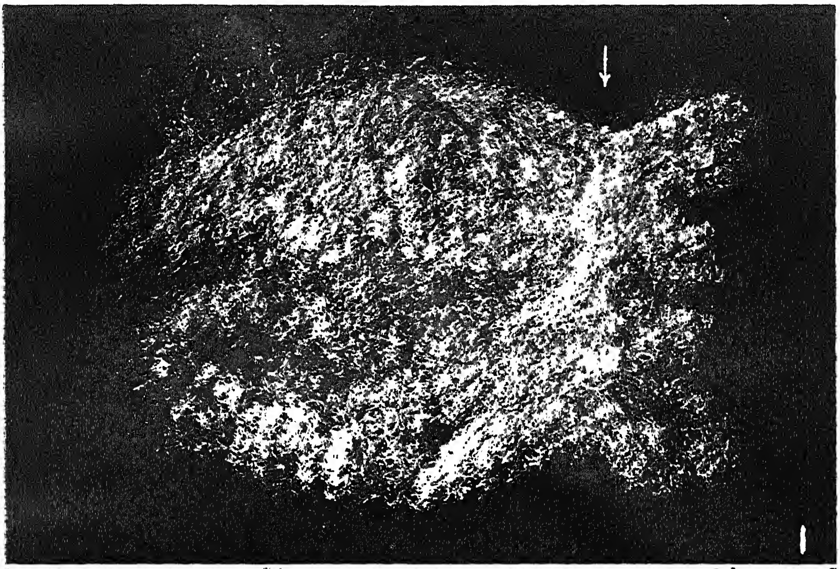
Table II.

Month during which Cotting occurred	No. of Cases 1923	1924	1925
November	1	—	—
December	1	1	1
January	3	4	2
February	6	13	7
March	4	1	1
April	—	3	—

A mathematical examination of these figures shows that the differences between the three years are not significant.

With regard to the yearling fleeces it is much more difficult to estimate the period at which cotting occurred. The exact dates of birth of the individual sheep are not known, the lambing period being spread over perhaps six weeks, and in addition some lambs are born with a coat which is already of appreciable length, while others possess a much shorter one. There is some indication in the case of these fleeces that cotting occurs slightly earlier on the average, but for the reasons given not much stress can be laid on this result. It may be concluded with fair certainty that the cotting process occurs during winter and spring, and that the great majority of cases occur during a limited period which is probably about February. There does not appear to be any appreciable difference in the time of occurrence of this period from year to year, at least as far as the three years under review are concerned.

PLATE I.



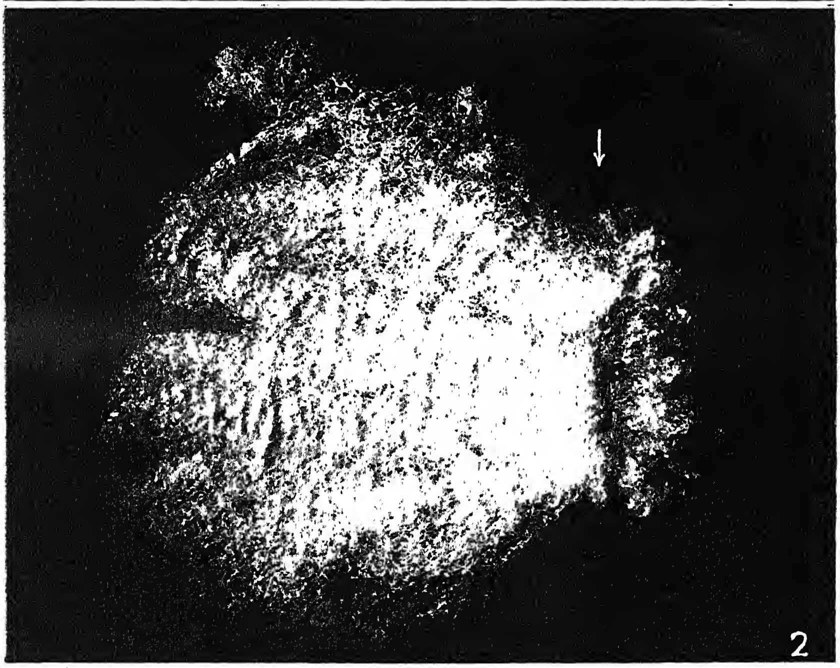


FIG. 1—Cotted Fleece. Grade 2.

FIG. 2—Heavily Cotted Fleece. Grade 1.

PLATE II.

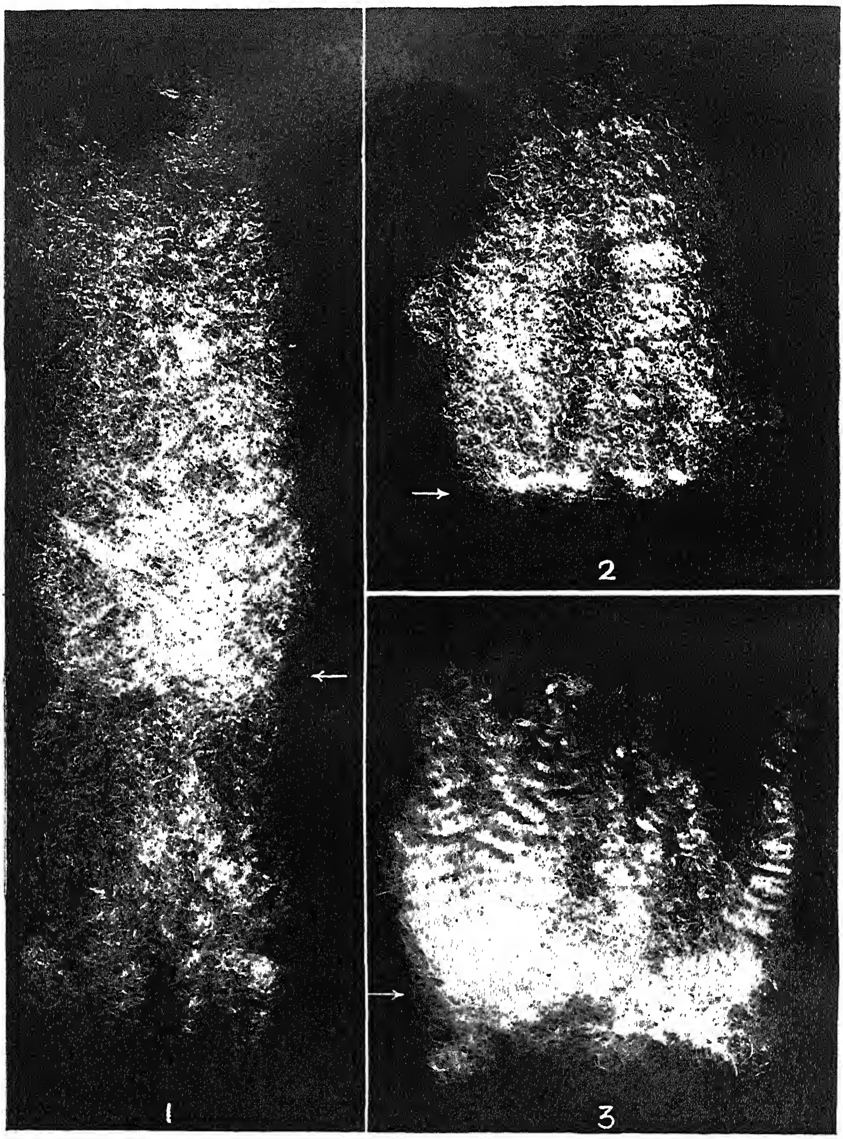


FIG. 1—Note height of line of cotting in staple. This was the highest found. Yearling Fleece. Grade 2.

FIG. 2—Line of cotting at bottom of staple. Grade 4.

FIG. 3—Heavily Cotted Fleece. Grade 1.

PLATE III.

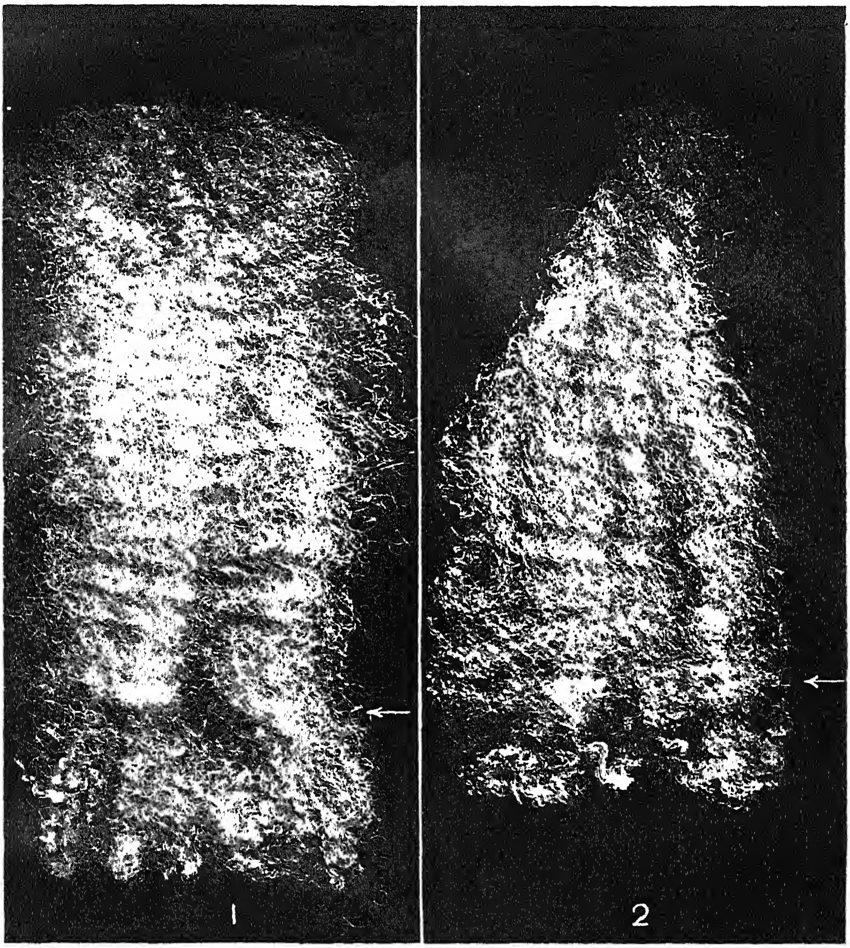


FIG. 1—Grade 3.

FIG. 2—Very Lightly Cotted Fleece. Grade 5.

PLATE IV.

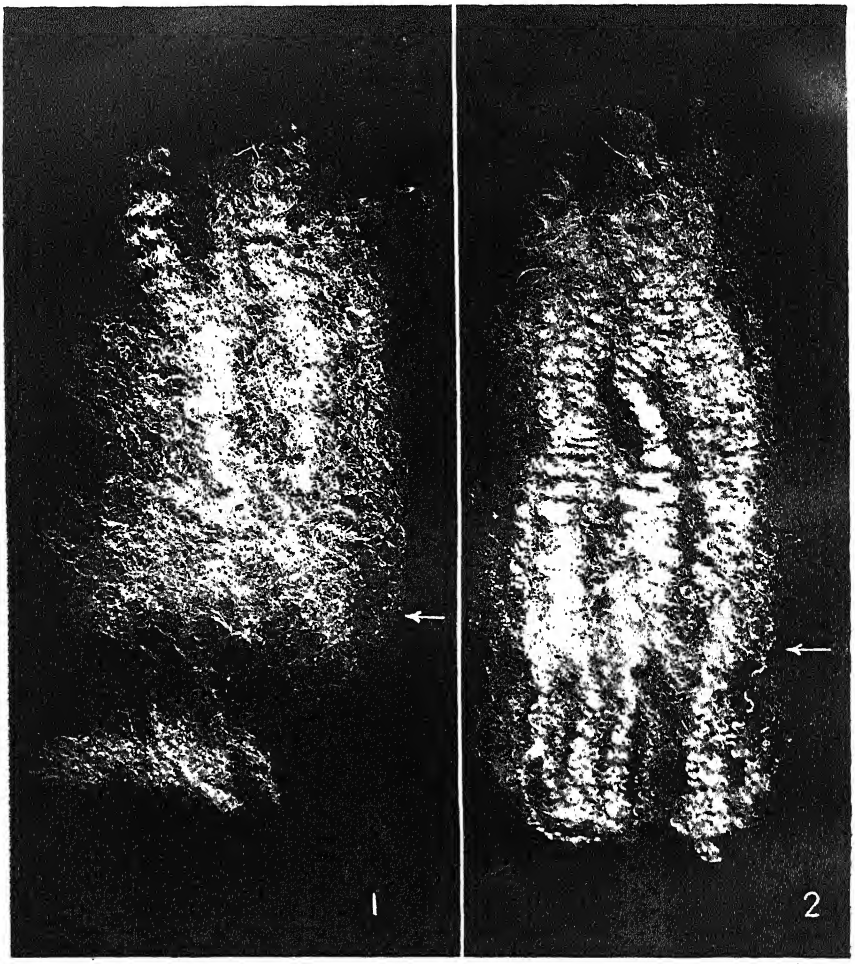


FIG. 1—Most of this fleece was shed. Grade 4.

FIG. 2—Note discontinuity of elements forming staple. Grade 4.

THE SIGNIFICANCE OF AND THE POSSIBLE CAUSES UNDERLYING THE PARTIAL SHEDDING OF THE FLEECE

An examination of the data makes it possible to answer three additional questions that have a close bearing on the problem of the occurrence of the cotted fleece.

Is the Tendency to Produce a Cotted Fleece Constitutional?

In the case of 57 sheep, samples were available for two consecutive years. In the first year 23 of these were cotted. If there were no constitutional tendency towards cotting, the proportion of cotted fleeces in the second year should be the same in the case of the 23 sheep which were cotted in the first year, as it is in the 34 which were not cotted in the first year. Actually in the second year 13 of the 23 fleeces previously cotted were again cotted, and of the 34 not previously cotted only four. This is a clear indication that the tendency to produce a cotted fleece is to some extent characteristic of certain individual sheep. Such a sheep will not infallibly produce a cotted fleece, but will be more likely to do so than the average. Of the 13 fleeces cotted in both years, seven showed a higher grade of cotting in the second season; three showed the same grade; and three a lower grade. There does therefore seem to be a tendency for a sheep which possesses a cotted fleece to exhibit in a subsequent year a more severely cotted fleece. The figures, however, are small and many more observations are required fully to substantiate this point.

Has Cotting or the Degree of Severity of Cotting any Relation to the Age of the Sheep?

The facts are presented in the following table—

Table III.

Age of Sheep in Years	Cotted Fleeces										Fleeces not Cotted	
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5			
	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age
1	1	1·2	2	2·3	—	—	2	2·3	9	10·5	72	83·7
2	2	3·8	2	3·8	—	—	4	7·5	4	7·5	41	77·4
3	—	—	—	—	2	4·6	3	7·0	5	11·6	33	76·8
4	1	3·0	4	12·1	1	3·0	4	12·1	3	9·1	20	60·7
5	1	5·1	2	11·1	1	5·1	3	16·6	2	11·1	9	50·0
6	1	9·1	—	—	1	9·1	1	9·1	3	27·3	5	45·4
7	—	—	—	—	—	—	—	—	1	50·0	1	50·0

To obtain a clearer view of the situation, grades of cotting 1–3 and 4–5 are grouped together in the following table—

Table IV.

Age of Sheep in Years	Percentage Cotted Fleeces: Grades 1–3	Percentage Cotted Fleeces: Grades 4–5	Percentage Fleeces not Cotted
1	3·5	12·8	83·7
2	7·6	15·0	77·4
3	4·6	18·6	76·8
4	18·1	21·2	60·7
5	21·3	27·7	50·0
6	18·2	36·4	45·4

It will be seen that there is a well marked tendency for cotting to increase with the age of the sheep. This is, however, only an average. For example. one sheep only one year old shows the highest grade of cotting. The figures are too scanty to support a very detailed analysis, and it is only possible to indicate the probability that cotting becomes more severe as well as more frequent in older sheep. The chief effect of age appears to be, however, to increase the number of cotted fleeces.

Is there any Variation from Season to Season in a given Flock in the Proportion of Sheep with Cotted Fleeces?

Comparable figures are available for the seasons 1923, 1924, and 1925.

Table V.

Season	Cotted Fleeces										Fleeces not Cotted	
	Grade 1		Grade 2		Grade 3		Grade 4		Grade 5			
	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age	No. of sheep	Per-cent-age
1923	—	—	2	3·0	2	3·0	8	12·1	17	25·8	37	56·1
1924	5	5·5	6	6·6	2	2·2	5	5·5	7	7·7	66	72·5
1925	1	1·4	2	2·8	1	1·4	4	5·5	3	4·2	61	84·7

Again, for convenience, a shortened table is given in which grades of cotting 1–3 and also 4–5 are grouped together.

Table VI.

Season	Percentage Cotted Fleeces Grades 1–3	Percentage Cotted Fleeces Grades 4–5	Percentage Fleeces not Cotted
1923	6·0	37·9	56·1
1924	14·3	13·2	72·5
1925	5·6	9·7	84·7

There is an undoubted variation from season to season in the proportion of sheep exhibiting cotted fleeces. It will be seen that in 1923 and in 1925 the percentage of sheep with cotted fleeces of Grades 1–3 is low. In 1924 and in 1925 the percentage of sheep with cotted fleeces of Grades 4–5 is very low compared with the corresponding figures of 1923. It can be concluded that 1925 was a good year for absence of cotting and 1924 a bad one, especially as regards the higher grades. The figures for 1923 require a little additional explanation; of the 29 sheep shown as cotted in that year, no less than 12 were yearlings and the fleeces of these sheep with one exception all fell into Grades 4 and 5. In 1924 only three yearlings had cotted fleeces, and in 1925 none. The heavy percentage of lightly cotted fleeces in 1923 is largely due therefore to the fact that in that year some factor was operating which particularly affected the yearlings. Fourteen samples taken from the yearlings in 1920 were also available for examination, and in this case too none were cotted.

The considerations that have been discussed make it possible to gain some insight into the nature of the influences responsible for cotting and into

their mode of action. First of all, the evidence seems to point clearly to what may be called a "susceptible period." If it were possible for the action of external influences to induce cotting at any time, it is most improbable that not a single case in which the process took place in summer or autumn should have been found. In addition, the extreme limits in time during which the process was found to have occurred are wide, and there is no reason mechanically why cotting should not occur twice in the same individual during a single season unless the assumption is made that each sheep is only susceptible during a limited period to the external or internal influences that are responsible for the partial shedding of the fleece. It need not be maintained that for the cotting process to occur in summer or early autumn is an absolute impossibility. This may or may not be true, but there is considerable reason for holding that if such a result were obtained it could only be due to some extraordinary condition or method of treatment quite outside the normal range. A note of caution should perhaps be struck here; the data refer to a single flock and it is just conceivable, though most improbable, that the management of this flock might be responsible for this result. The sheep receive practically no food other than grass, and therefore the period of greatest shortage would occur about February, March, and the beginning of April. If such an explanation is adopted it is difficult to account for the fact that cotting does not occur twice within a single season. In any case, the discussion is intended to be suggestive and not a conclusive argument in favour of a definite hypothesis.

Another most significant fact is that although there are wide seasonal variations in the proportion of sheep in the flock possessing cotted fleeces, the period of the year during which the process has taken place does not vary appreciably. Again, it is difficult to account for this unless the existence of a susceptible period is assumed. If such a period did not exist, it would be difficult to explain why the influences responsible for the cotted fleece should show such wide variations in intensity from season to season, and at the same time always act at the same period of year (and for the most part within such narrow limits). It is known that there occurs in the Welsh Mountain breed as in many others a phenomenon known as the "rise" in the wool, which is characterised by the fibres composing the fleece becoming finer in diameter, though few would normally be shed. Until work has been carried out which will furnish an exact description of this process, and in particular define the limits in time during which it occurs, it is impossible to form any very rigid conclusions relative to the possible relationship of the rise to cotting. That there is some relationship is probable, and it is quite reasonable to imagine that some factor or factors operative at the time of the thinning might push the process further and so a partial shedding would result. The analysis has so far led to the recognition of an individual tendency towards cotting which is certainly constitutional and probably hereditary, a tendency that becomes more marked with age; secondly, the analysis indicates a susceptible period spread over several months in the case of the whole flock though confined to a fairly limited period as far as the majority of cases are concerned, and probably there is also an indication that the susceptible period in the case of any individual sheep is confined to a short and definite period. (The data are unfortunately insufficient for any answer to be given to the question as to whether the time of year is the same in the case of an individual sheep in which the process occurs in successive years.)

It is perhaps not very profitable to speculate at any length as to the exact nature of the influences which act on a susceptible individual at the susceptible time, but a few considerations may be mentioned. These factors vary considerably from season to season and might be nutritional, climatic, or connected in some cases with pregnancy, which in the case of ewes bearing lambs terminates about the time at which the process occurs. It is not improbable that the rhythm in the growth of the fleece, as shown, for example, by the rise in the wool corresponds to a rhythm in the general metabolism of the sheep, and such a factor as thyroid activity is just the sort of mechanism that might be anticipated. The "external" stimulus to cotting might well be due to influences, *e.g.* nutrition that result in variations in thyroid functioning. It might be mentioned that in the case of this particular flock, at least dipping had nothing to do with the cotting process. In no case were the sheep dipped in the period during which the process occurred. The writer has examined fleeces that have been said to have been "damaged" by dip, but these were not cotted; tensile strength, &c., may have suffered, but in most cases the most obvious phenomenon was only a deposit of adherent material on the surface of the fibres. The writer has also had, however, the opportunity of examining very heavily cotted fleeces from a flock where the cotting was universal and unquestionably due to dipping, but this was an exceptional case; the sheep had been dipped for a particular purpose repeatedly at short intervals and *during the susceptible period.*

In conclusion, it may be stated that any research that had for its object the discovery of all the factors that result in cotting, and the search for methods of prevention, would fall naturally into two groups—

1—An analysis of the hereditary tendencies involved, *i.e.* the question as to whether cotting could be eliminated by the weeding out from the flock of certain individuals.

2—A determination of the environmental and physiological factors involved, a study that would depend on both observation and experiment. In fact, the apparently simple problem of cotting leads on naturally to the physiology of the growth of the fleece in the widest sense.

The writer wishes to express his thanks for helpful criticism and advice to Dr. F. A. E. Crew and to Professor R. G. White, of the University College of North Wales. He is also indebted to Mr. James Briggs, of Elland, who graded the fleeces in connection with the main scheme.

SUMMARY

(1) This study is based on the examination of samples from 246 fleeces from the pedigree Welsh Mountain flock of the University College of North Wales, taken in 1920, 1923, 1924, and 1925.

(2) For the sake of convenience, five grades of severity of cotting were arbitrarily fixed. Only the most severely cotted grade, 1, would correspond to the technical definition of cotting, but useful information can be deduced from samples which exhibit the same process at work to a lesser degree.

(3) Cotting is due to a shedding of some of the fibres composing the fleece, the fine terminal portions of such fibres becoming intertwined.

(4) The cotting process takes place in various individual sheep during winter and spring, but the great majority of cases occur during a comparatively limited period, which is probably about February. The time of the occurrence of this period does not appear to vary appreciably from year to year.

(5) The tendency to produce a cotted fleece is largely constitutional, *i.e.* is characteristic of the individual sheep. The proportion of sheep affected becomes greater with age, and also there are big variations in the proportion of cotted fleeces in the same flock from season to season. The evidence points to variable factors which act during a susceptible period on sheep of varying individual susceptibility. Such factors are probably intimately connected with the metabolism of the sheep.

17—COLOUR INHERITANCE IN THE WENSLEYDALE BREED OF SHEEP

By F. W. Dry, D.Sc.

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INTRODUCTION

In conducting breeding experiments with sheep, extending over several years, the temptation is to delay the publication of the results, year by year, until in fact the investigation is brought to a conclusion. Each lambing season, it is next year's results that one really wants. In the research now to be discussed, the original series of experiments, which has been in progress for the past three seasons, is not yet finished, being continued for at least the present breeding season, but the work has reached a point at which a new departure, aimed at practical results, has seemed justified. The object of this paper is to give a general account of the work done up to the present time.

In the Wensleydale breed, as is well known, a large proportion of black lambs are born, although black animals are not used for breeding. The actual percentage, including the small numbers of silver-grey lambs, is about 15%. The proportion is much the same as it has been for many years. The animal desired by Wensleydale breeders has the skin of the extremities of the body, especially of the head region, deep blue in colour. Some sheep are not as blue as the desired standard, just a few being very pale. An occasional ram used in a pedigree flock dose not sire a single black lamb, but has his entire family composed of whites. A few lambs are silver-grey rather than black, bearing a fairly even mixture of black and white fibres, but until the experiments are dealt with it will be enough to distinguish White and Black. These are the broad facts from which the investigation started. In the light of all that is known of colour inheritance in smaller animals, one could at once be sure that these facts would lend themselves to interpretation along Mendelian lines. At the outset, suggestions as to possible relationships between the different colour types could be made, but the truth of any hypothesis remained to be tested. The additional evidence needed has been secured in two ways. Firstly, the experience of breeders has been collected and flock records analysed. An account of what was learnt in this way has already been published.* Secondly, breeding experiments have been carried out, and though they seem to be nearing completion, are still in progress.

INFORMATION FROM BREEDERS AND FLOCK RECORD ANALYSES

The information obtained from breeders may be briefly reviewed. The most valuable data were supplied by Mr. G. Goland Robinson, who kept detailed records of the flock of Lord Henry Bentinck, M.P., at the Underley Farm, near Kirkby Lonsdale. Mr. Robinson's records covered the whole period during which this flock was maintained, from its foundation in 1897

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to its dispersion in 1922. At the time this inquiry was taken in hand Mr. Robinson was Honorary Secretary of the Wensleydale Longwool Sheep Breeders' Association, and, as he has continued to do, gave every possible assistance. It has also been my privilege to visit a large proportion of the owners of registered flocks, and to meet most of the members of the Council of the Association again and again. When the organisation of the breeding experiments is explained, it will be shown again how many people have helped in this investigation.

First, a word may be said about the blue complexion. The great function of the Wensleydale breed, which numerically is a small one, is to provide rams for cross-breeding, a large proportion of all the males born being sold for breeding purposes. Mated with Black-faced Mountain ewes, rams with a deep blue complexion are stated to sire lambs with darker mottled faces than rams that are paler in complexion. Cross-bred lambs so marked are more in favour with butchers, giving, it is said, a higher proportion of lean meat. These are the statements of breeders, though it should be added that while the majority of those interested in a substantial way in cross-breeding attach this importance to the blue colour, this is not true of all. The possibility that these statements may be true cannot be questioned in view of analogous cases in smaller animals. On these points detailed studies are called for. In any case, the deep blue complexion certainly is the trade mark of the Wensleydale breed, distinguishing it in a striking manner from other longwools. One can sympathise with the feeling that from the standpoint of beauty the blue complexion is a distinct asset.

One piece of information which early came to hand was specially welcome, because it gave the result of a mating which would never be made in an ordinary flock, and had this mating not already been tried it must have been made in one of the first breeding experiments. Black Wensleydales mated together produce nothing but black lambs. Two gentlemen owning parks felt that flocks composed entirely of black sheep would present a pleasing appearance. Each flock was made up of typically black animals born in registered flocks. Mr. F. Samuelson, of Breckenborough Hall, near Thirsk, recorded sixteen lambs. For the facts about the other flock I am indebted to Mr. E. G. Howsin, Estate Agent to Colonel Starkey, on the Huntroyde Estate, at Padiham, near Burnley. This flock consisted each year of about forty ewes and was kept up for ten years. Many of the later breeding sheep, both ewes and rams, were born in the flock, others being added from pedigree white flocks. Some six hundred lambs were bred, none of them white, and none of them classified at birth as silver-grey. From the point of view of this investigation, each gentleman keeping a black flock was performing an essential experiment. In the case of the larger flock this experiment was carried out in a far more thorough-going manner than has been possible in any of the series started in 1922.

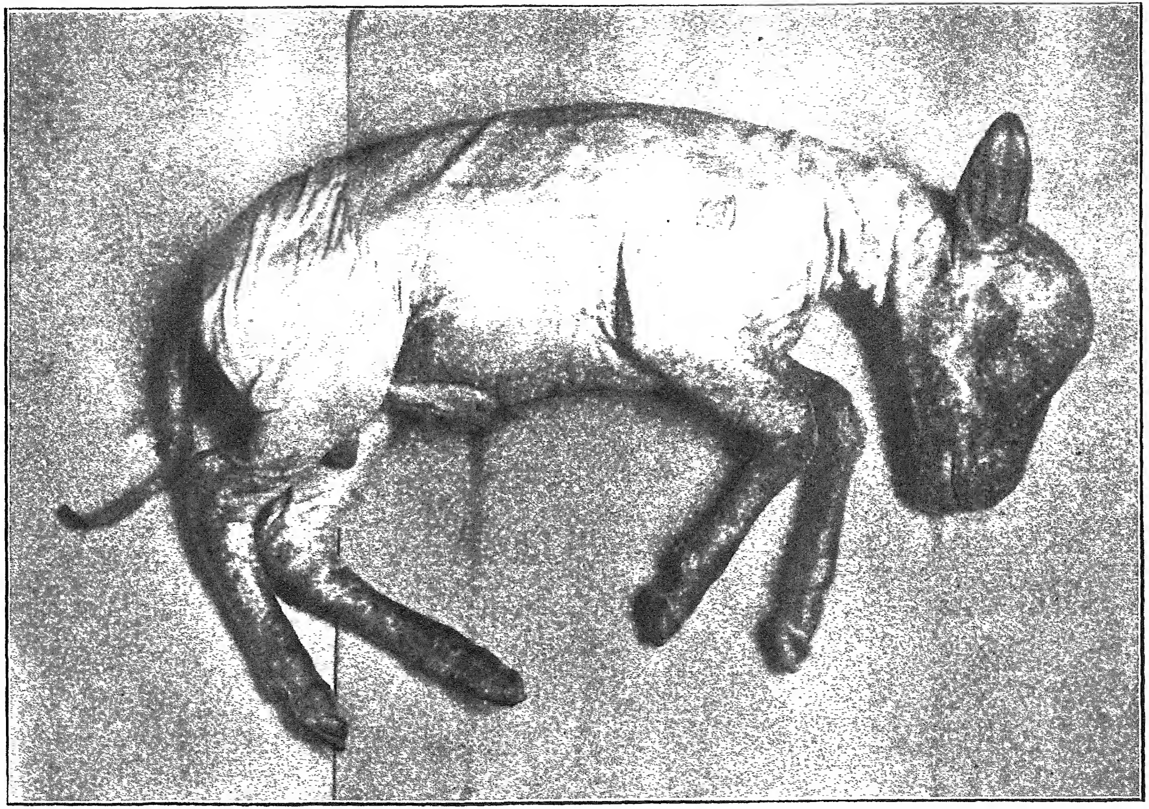
Whites can produce blacks. Blacks mated together give nothing but blacks. Clearly black is recessive to white. The question next arises, is Black a simple recessive, or are matters more complicated? If Black is a simple recessive, then when white animals that are all capable of producing blacks are mated together we should get in large numbers the well-known 3:1 Mendelian ratio, three whites to one black. Any white animal able to have black offspring at all would, when mated with blacks, give approximately equal numbers of whites and blacks, provided the numbers were

large enough for a sufficient test. If, however, we are concerned with two different Mendelian factors, so that Black is a double recessive, the numerical results in those matings would be different. Whites selected at random, all able to be the parents of black lambs, would, mated together, have fewer blacks than one in four in the aggregate. Whites mated with blacks would some, as in the other case, have half their lambs black, but others would give only one black lamb in four. On surveying the facts gathered from breeders one may well suppose Black to be a double recessive. Leaving out the families of the few rams that established all-white records, the proportion of blacks born is definitely less than one in four. At Underley, on almost three thousand lambs, the percentage of blacks was 20·8. Data from other sources give not quite 16%, on nearly four thousand lambs. Again, some rams have a larger proportion of blacks in their families than others. At Underley, in the offspring of those rams which sired a hundred lambs or more, the percentages of blacks varied from 16 to 29. Many a ram has been discarded because he was believed to be specially prone to bring black lambs. It is probably the general belief amongst breeders that differences in the percentages of blacks in the families of rams are due to inborn differences between the rams. Obviously, this is a question not solely of academic interest. Fortunately, the Underley records give a pretty clear answer to the question whether Black is or is not a simple recessive. This is obtained by the use of a simple statistical device in the study of the families of the individual ewes. In the light of this analysis, one may think of Mr. Robinson, in managing the Underley flock for a quarter of a century, and keeping complete records, as carrying out a long period breeding experiment which is fairly critical for the point under discussion. In making this analysis the lambs sired by a ram that never in a long career became the father of a black are regarded as non-existent, and the families of a small number of ewes are omitted where any lamb was the offspring of some ram that sired only a small number of lambs, and so, although the lambs were all whites, did not prove whether he was really able to beget a black. As five was the average number of lambs composing the family of a ewe, it inevitably came about that many ewes never had a black lamb. It is with those families that did include at least one black that we are concerned. The method of statistical treatment is that employed by Jones and Mason.* Suppose Black to be a simple recessive. For families consisting of one lamb and including a black, the proportion of blacks is necessarily 1. For families of two the proportion will be somewhat more than ·5 and so on, gradually approaching ·25 as the size of the family increases. For each size of family Jones and Mason calculate the expected number of recessives—in our case black lambs—from a modified Mendelian ratio which allows for the omission of all families not containing any such animal. The proportion is calculated from the formula—

$$X = \frac{1}{4\left[1 - \left(\frac{3}{4}\right)^{n}\right]},$$

where n is the number of offspring in the family. It will be seen from the table that the figures obtained from the Underley data agree very closely with expectation, and justify the conclusion that Black is a simple recessive.

*Jones, D. F., and Mason, S. L. (1916). "Inheritance of Congenital Cataract," *Amer. Nat.*, Vol. L.



Wensleydale fœtus with white wool just beginning to grow; from black ewe, sire *Lundholme Pippin II.*, a ram with an all-white record; extremities of the body deeply pigmented. One-third natural size.

Underley Flock—Analysis of the Families of the Ewes which Produced at least One Black Lamb

Size of Family	Number of Families containing Blacks	Number of Blacks	Expected if Black be a Simple Recessive: Calculated Proportion of Blacks	Expected if Black be a Simple Recessive: Calculated Number of Blacks
1	5	5	1·0000	5·00
2	37	45	·5714	42·28
3	44	64	·4324	57·08
4	44	62	·3657	65·36
5	36	58	·3278	59·00
6	41	73	·3041	74·81
7	35	85	·2885	70·68
8	27	63	·2778	60·00
9	20	34	·2703	48·65
10	12	28	·2649	31·79
11	10	27	·2610	28·71
12	6	18	·2582	18·59
13	3	9	·2561	9·99
14	3	10	·2546	10·69
16	2	11	·2525	8·08
		592		590·71

If Black be a simple recessive, it follows that white Wensleydales may be divided into two classes—(1) Duplex or homozygous whites, sheep incapable of having black lambs even if mated with blacks, and (2) simplex or heterozygous whites, sheep that do have black lambs. Moreover, animals of the latter class if mated with blacks would all in the long run give approximately equal numbers of whites and blacks, any deviation from equality in small families being attributed to chance, just as in tossing pennies a small number of times the number of heads and tails may be by no means the same. These two types of ewes, we may be sure, exist in every flock of any size. Indeed, from the percentages of black lambs born we may calculate the proportion of duplex ewes. If 16% of the lambs are black and all the rams used sire some blacks, this means that four times 16%, or 64%, of the ewes can produce blacks and give the 3:1 ratio, and that the remaining 36% of the ewes can have only white lambs. Further, of the white lambs produced in those matings, where it is possible for blacks to be born, one-third will be duplex whites, while the duplex ewes being mated with simplex rams will give offspring half of them duplex, half simplex. Hence it may be calculated in the case under consideration that 34% of all the lambs born are duplex whites, or that of all the white lambs 40% are incapable of becoming the parent of a black. At Underley the proportions of duplex whites would be 17% amongst the ewes, and 29% of the total lambs, or 36% of the white lambs born. Two questions present themselves. Firstly, are we able to form any idea whether an untried animal can or cannot produce blacks? Secondly, if so many duplex ram lambs are born, how is it that so few are used in pedigree flocks? It may be said at once that there is no known method, other than a breeding test, of distinguishing with certainty between duplex and simplex whites. The difficulty of doing this will become very apparent when the results of the breeding experiments are given. Still, something has been learnt from the inspection of a number of rams with all-white records. Rather more than a score such animals have been heard of, most of them being no longer alive. I have examined eleven. Apart from the inside of the ears all these were blue enough in

impossible to find any fault with him on that point. One, while not the bluest of the blue there, did not fall far short. The rest in greater or less degree were on the pale side in this respect. Of the rams which died before I took up this work, those who used them say that a few were typically blue throughout, but several are said to have been somewhat pale inside the ears. Now, in selecting stock rams great importance is attached to colour within the ear. With so many animals from which to choose very few that are below standard in this respect find their way into pedigree flocks, although one or two such animals amongst those not siring blacks, thanks to other qualities, have been amongst the most successful sheep of their day in the show ring. The ewes, on the other hand, cannot be selected so keenly for colour. Two facts from the Underley records have bearing on this discussion. Firstly, the percentage of blacks born in that flock was distinctly higher than the average for the breed. Secondly, the percentage of blacks was substantially the same when the flock was dispersed as it was in the early years, in spite of the fact, of course, that all blacks were thrown out of the flock. Throughout the breed the endeavour is made to select for the blue complexion, but special attention was paid to this at Underley. It is, however, the case that some ewes most decidedly pale in colour inside the ears do have black lambs. Surveying all these points, it is safe to conclude that duplex whites are generally lacking in colour inside the ears, and that animals deep blue in that region are generally simplex whites. That is as far as one can go. In selecting for deep blue colour within the ears, breeders are keeping up the numbers of simplex whites, and so keeping up the numbers of blacks born, although blacks themselves are thrown out. In the case of the rams the selection can be very keen. With the ewes it is not possible to keep the colour standard so high, and many duplex animals are kept for breeding. In fact, in most flocks the proportion of gimmers taken into the flock that are simplex cannot be much higher than the proportion in all the gimmers born. This is the explanation adopted of the fact that the proportion of blacks born is less than one in four.

THE BREEDING EXPERIMENTS

When the results of the inquiries amongst breeders were tabulated Professor A. F. Barker, who has been interested in this colour problem for a long time, urged that no time should be lost in starting breeding experiments. The experiments were designed to explore further the relations between the colour types existing in the breed, their purpose being to test the views that had been formed, and to decide between alternatives where the available data did not warrant a definite opinion. A scheme was drawn up and discussed with the members of the Council of the Sheep Breeders' Association. The animals, mostly lent by some twenty breeders, were got together in the autumn of 1922. The experiments have been carried out by Mr. T. E. Clarke, at Challan Hall, Silverdale, Mr. A. G. Ramshay, at East Appleton, Catterick, and Mr. H. Stephenson, at Cowton Grange, Darlington. About seventy animals have in all been used for breeding. The first season most of the animals put to the ram were unavoidably only in their first year, and only a few lambs came along in the spring of 1923, but each of the last two seasons sixty or seventy lambs have been born. The expenses of the experiments have been met mainly by grants from the Ministry of Agriculture. The research as a whole has been supported chiefly by the funds of the Ackroyd Memorial Research Fellowship, with some

help from Clothworkers' Funds, at Leeds University. The general plan of the experiments has been to make those matings in which it was possible for the three colour types, White, Black, and Silver-grey to figure, about which information had not already been obtained, and to learn also something about the inheritance of complexion colour in white sheep. Animals which were not white were classed as black or silver-grey from the lamb fleece; typical examples of each were chosen. A summary of the results so far obtained is now presented.

I.—Experiments with Rams with All-White Records

(*a*) *Rams with All-White Records mated with Black Ewes.*—Two different rams which had established white records in Wensleydale flocks were used. *Bluebottle* sired 11 lambs, all whites, born in 1923. *Lundholme Pippin II.* was the father of 40 lambs, again all whites (1924). Both these rams were coppery in colour inside the ears. *Bluebottle's* lambs could all be classed as of good blue complexion, including the inside of the ears. The same is true of three-quarters of those by the second ram, but at the age of about four months four lambs resembled their sire in complexion and two were lighter still. Two of the former were used in Experiment (*b*), and retained until shearlings, and one of the two palest was also kept until a shearling. In all three the complexion showed no appreciable change.

(*b*)—*Two sons of Lundholme Pippin II. from the above experiment mated with Black Ewes*—The two rams resembled their father in being copper coloured inside the ears. The lambs were 27 whites and 20 blacks, including a few silver-greys by one ram, or approximately half and half (1925). The white lambs were many of them blue enough in complexion, but on the whole they were not a specially blue lot.

(*c*)—*Lundholme Pippin II. mated with White Ewes copper coloured inside the ears*—Ewes were chosen having complexions like that of the ram. Twelve white lambs resulted (1925). These included some darker and some lighter than the parents; on the whole they were light.

II.—Black Rams mated with White Ewes of very Pale Complexion

This mating was made each season, six different ewes having lambs. Sixteen white and two black lambs were obtained. Most of the whites were deep blue in complexion, but some were quite pale. The two blacks were both from the same ewe, the palest of the six.

III.—Silver-greys mated together

This mating was made every season, five different rams being used. There resulted 26 silver-greys and six blacks. No whites were born.

Two other experiments are now in progress. These matings are White × Silver-grey and Black × Silver-grey.

PRESENT POSITION DISCUSSED

The present position of the investigation may now be considered in the light of the breeding experiments. The results of these are consistent with the views adopted before, but it is upon the analysis of the Underley records, not upon the experiments, that the conclusion that Black is a simple recessive rests. The relation between the three colour types, White, Silver-grey, and Black, may be stated as follows. It is possible for whites mated together to produce all three types; this, of course, happens in white Wensleydale flocks. Silver-greys mated together have given mostly silver-greys, some blacks, no whites. Blacks mated together produced nothing but blacks.

The three types therefore appear to form an epistatic series, White dominant to Silver-grey, and Silver-grey dominant to Black. It is of practical importance to know that silver-greys mated together do not produce whites. At the outset the possibility was kept in mind that with silver-grey parents on both sides the offspring might consist of blacks, silver-greys, and whites of pale complexion in the ratio 1:2:1. Were that so, blacks mated with whites of pale complexions would be expected to give lambs all silver-greys. These results have not come about. The point is this. Had silver-greys given any whites, these, being recessive whites, could have been counted on to breed true, like black Wensleydales, and as the Albino does in so many species of animals. Could that be done we should have a simple way of establishing an all-white flock, but now we know that we cannot hope for anything in this direction. It is upon the duplex whites that attention must be concentrated. Which whites are duplex and which simplex, as has been stressed already, we cannot determine by sight, and this difficulty has been emphasised by the experience gained in the experiments.* To mention only the most striking fact, black lambs were produced by the white ewe with the palest complexion found in a special search for pale animals.

ATTEMPT TO ESTABLISH A PURE WHITE FLOCK

It now remains to describe briefly the new work taken in hand in the mating season of the autumn of 1925. This has for its aim the eventual establishing of a flock of duplex whites. All the animals chosen are at least a little pale in colour inside the ears. A score of ewes have been secured that in families of five or more have never had a black, and that by rams known to be able to sire blacks. Some of these ewes, as well as a couple of gimmer hoggs that have been included, are daughters of rams whose lambs have all been white. These animals have been divided between two elderly rams that have made good their all-white reputations. It is, of course, anticipated that all the lambs will be white. Some forty black gimmers have also been bought. These are nearly all hoggs, it being necessary to secure them a year in advance to prevent them from being sent to the butcher. In the autumn of 1926 the plan will be to mate some of the ram lambs with these blacks. A ram siring eight lambs all whites from black ewes is virtually certain to be a duplex white. In this way it is hoped to obtain by the summer of 1927 a small number of shearling rams which can be guaranteed never to sire blacks from any Wensleydale ewe. From the gimmer lambs a selection would be made of animals to be put in due course to rams known to be duplex whites, and so on with succeeding generations. The proportion of duplex whites in such a flock would be expected gradually to increase. The breeding tests of the rams would show what progress was being made. Rams brought into the flock must, of course, have established their claim to be duplex whites. Eventually, breeding on these lines, it can confidently be said that the trial matings could be dispensed with, and that after some years one could be satisfied that none of the animals in the flock could have a black lamb with any Wensleydale mate whatever. For the present the inconvenience of breeding tests must be faced unless the production of guaranteed rams is to be postponed for a very long time.

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*This and other fundamental problems that present themselves in this Wensleydale work have been discussed in a recent review in this *Journal* (1925, **16**, P266).

18—THE DETECTION AND ESTIMATION OF GLYCEROL IN COTTON CLOTHS AND SIZED YARNS*

By George Smith, M.Sc., A.I.C.

Glycerol, in the form of various grades of commercial glycerine, is used to a considerable extent in both the sizing and finishing trades, and it is therefore surprising that the published schemes of chemical analysis of yarns and cloths in no case include reliable methods for either the qualitative detection or the estimation of this substance.

QUALITATIVE

Dannerth[1] states that glycerol in sized cloth may be detected by the production of acrolein when a concentrated aqueous extract of the cloth is heated with potassium hydrogen sulphate. This test is not sufficiently selective, nearly all sized cloths giving a positive reaction, whether containing glycerol or not. A preliminary investigation of a number of other tests for the identification of glycerol showed that the most suitable for the purpose in hand is the Schotten-Baumann method of benzoylation in aqueous solution, whereby is obtained a crystalline glyceryl dibenzoate, m.p. 72–73° C.[2] The reaction, crystallisation of the product from alcohol, and determination of the melting point, can be carried out easily, using 0·05 gram of glycerol in dilute solution. A method has therefore been devised for obtaining from cloth or yarn an extract containing the glycerol sufficiently free from other constituents of the size and of the cotton to allow benzoylation to proceed normally. The only other method of testing for glycerol which has given satisfactory results when applied to sized cottons is that of Denigés,[3] depending on the oxidation of glycerol, in aqueous solution, to dihydroxyacetone, and the production of distinctively coloured bodies when this is condensed with phenolic substances in the presence of concentrated sulphuric acid.

The Benzoylation Test

Method of Extraction—A suitable quantity of yarn or cloth—about 20 grams of a pure-sized cloth—is extracted for three hours in a Soxhlet apparatus with 95% alcohol. The extract may contain, in addition to glycerol, zinc and magnesium salts, soap and fatty acids from the size, and waxy matter, together with substances not yet identified, from the cotton itself. Most of the wax separates on cooling the alcoholic solution, and may be filtered off. In the case of a more heavily sized cloth, where glycerol, if present at all, will occur in comparatively large amount, a much smaller quantity of the sample is extracted, usually 5–10 grams, and the amount of wax obtained in the alcoholic extract is so small that filtration at this point may be omitted. The alcoholic solution is evaporated on the water-bath to about 2 cc. and is then shaken with 20 cc. of warm, very dilute hydrochloric acid. The cooled mixture is filtered, or extracted with ether, to remove all fatty matter, and is next boiled with a very slight excess of sodium carbonate in order to precipitate zinc. When all the liberated carbon dioxide has been driven off, a few drops of 10% caustic soda are added, to complete the precipitation of magnesium. The solution is filtered, carefully neutralised with hydrochloric acid, and evaporated to approximately 5 cc. If zinc and magnesium are known to be absent, the solution, after removal of the fatty matter, may be neutralised with caustic soda and evaporated at once. The benzoylation reaction is carried out with this solution.

* This and the following paper were read at a meeting of the Lancashire Section of the Institute on 12th February. The discussion follows on pages T206-T212.

Benzoylation—The reaction is best performed with a considerable excess of benzoyl chloride. The glycerol extract is shaken with 1 cc. of benzoyl chloride and 5 cc. of 10% caustic soda solution, together with one drop of methyl red indicator solution. As soon as the precipitated glyceryl benzoate turns red more caustic soda is added, a few drops at a time, with vigorous shaking, until the odour of benzoyl chloride disappears. The somewhat oily product is filtered off, washed with water and then dissolved, without drying, by pouring 2 cc. of boiling alcohol through the filter, which should be very small. The alcoholic solution is allowed to crystallise slowly, preferably in a small test tube. At first some oily substance separates, apparently the benzoate of some unidentified constituent of cotton which is extracted by alcohol and is not removed by the method of purification described. If the crystallisation is allowed to proceed slowly, the whole of the oily substance separates first, and the glyceryl benzoate crystallises above it as clusters of fine needles which are readily separated from the viscous oil, and which, without further purification, have a sufficiently sharp melting point.

Experimental—The test, as described, has been performed on a number of typical yarns and cloths, of known composition, some of which, containing no glycerol, were used in order to find whether any interfering substance is likely to be present in cottons or in the more common sizing materials. For each of the samples containing glycerol the approximate percentage of the latter on the material, calculated from sizing data, is given.

SAMPLE No. 1—90's Egyptian yarn, pure size. The size contained glycerine, japan wax, spermaceti, starches, and zinc chloride. Amount of glycerol in yarn, approximately 0·3%; 20 grams of yarn was used for the test, carried out as described. Obtained pure white needles of the benzoate, m.p. 71–72° C.

SAMPLE No. 2—Tinted cloth, the warp sized to add 30% weight. The size contained glycerine, spermaceti, starches, china clay, magnesium sulphate, salicylic acid, and a small amount of direct cotton dyestuff. Approximate amount of glycerol in cloth, 0·8%. The test was performed with 10 grams of the sample. Obtained pure white needles, m.p. 71–72° C.

SAMPLE No. 3—Tinted cloth, the warp sized to add 100% weight. The size contained glycerine, wheaten flour, starch, china clay, magnesium sulphate, zinc chloride, and direct cotton dyestuff. Amount of glycerol in cloth approximately 2%. 7 grams of cloth was used for the test. Obtained an abundant crop of benzoate crystals, m.p. 71–71·5° C.

SAMPLE No. 4—Plain cloth made from very coarse American yarns. The size contained the same ingredients as No. 1. The amount of glycerol in the cloth was 0·1%. 50 grams of cloth was used for the test. The purified extract was very dark coloured, but on benzoylation gave a pure white product, m.p. 70–72° C.

SAMPLE No. 5—44's American yarn, sized to add 50% weight. The size contained tallow, wheaten flour, starch, china clay, magnesium chloride, zinc chloride, and dyestuff. It contained no glycerol. 25 grams of the sample was taken for the test. Benzoylation gave only a small quantity of oily and uncrystallisable product.

SAMPLE No. 6—90's Egyptian yarn, pure size. The size contained fats, starches, and zinc chloride. It contained no glycerol. 20 grams of yarn gave a small amount of oily benzoate, which could not be crystallised.

Colour Reactions

Since Denigés' publication[3] is not readily obtainable in this country, the method of carrying out the tests is given here.

> 0·1 gram of glycerol (in dilute solution if necessary) is heated on the water-bath with 10 cc. of a 0·3% solution of bromine for 20 minutes. If, at the end of that time, it is still coloured, the solution is heated further, with constant shaking, until the yellow colour of the bromine has entirely disappeared. This solution is subsequently designated "Solution G." If the amount of glycerol available is less than 0·1 gram, the same quantity of bromine is still used. "Solution G" may, if desired, be concentrated to one-tenth its volume in order to render the reactions more distinct.
>
> "Solution G" gives the following reactions. All the phenolic bodies are used in 5% alcoholic solution.

Solution G	Phenolic Body	Sulphuric Acid (strong)	Method	Result
0·2 cc.	0·1 cc. Codeine ...	2 cc.	Heat on water bath for 2 minutes	Clear greenish-blue
0·4 cc.	0·1 cc. β-Naphthol ...	2 cc.	,,	Emerald green solution with strong green fluoresence
0·4 cc.	0·1 cc. of 4% potassium bromide and 0·1 cc. salicylic acid *	2 cc.	,,	Violet or wine red colour
0·4 cc.	0·1 cc. Thymol ...	2 cc.	In the cold	Pale rose to blood red
0·4 cc.	0·1 cc. Resorcinol ...	2 cc.	,,	Yellow to orange

*A drop of methyl salicylate used instead, gives, in the cold, intense violet colour, while guiacol gives a blue-violet colour.

R. Delaby[4] states that only one of the colour reactions, that with codeine, is specific for glycerol, all the other reactions being given by glycerol homologues.

Experimental—A number of yarns and cloths were tested in order to find whether the above reactions are applicable to the characterisation of glycerol in size. 5–10 grams of yarn or cloth was extracted with 95% alcohol in a Soxhlet. The alcoholic extract was evaporated nearly to dryness, the residue warmed with a few cc. of very dilute acid, filtered, and evaporated to about 1 cc. The oxidation with bromine was performed on this solution. In cases where the concentrated alcoholic extract was very dark coloured it was evaporated with a little hydrochloric acid till syrupy. Some charring of organic matter took place, and on addition of water and filtration, a clear solution, only slightly coloured, was obtained. In all cases the volume of "Solution G" was adjusted to about 5 cc.

Sample No. 7—Yarn, sized for weaving only, containing approximately 0·5% glycerol. The correct colours were obtained with thymol, codeine, β-naphthol, salicylic acid, and salicylates. Resorcinol was not used, since a distinct brownish-yellow colour was obtained in the absence of any phenol.

It was found that phenyl salicylate, in 5% alcoholic solution, gives a better reaction than either the free acid or the alkyl salicylates.

Sample No. 8—Cloth, heavily sized, containing 2·5% glycerol. The correct colours were obtained with all the reagents.

Sample No. 9—Cloth, heavily sized, containing no glycerol. Phenyl salicylate gave a very pale reddish colour. Codeine gave no colouration. Thymol gave an orange-red colour. β-Naphthol gave a deep fluorescent green. Repeat tests on this cloth gave always the same result. Thymol and β-naphthol were therefore not used for further tests, and codeine and phenyl salicylate alone retained.

Sample No. 10—Cloth containing approximately 1·5% glycerol, sized medium weight. Phenyl salicylate gave an intense violet colour, codeine pure greenish-blue.

Sample No. 11—Cloth containing 0·2% glycerol, pure size. Phenyl salicylate gave a strong purple colour, codeine gave pale brown. Several repeat tests with this cloth gave invariably a strong positive reaction with phenyl salicylate, but no blue colour with codeine.

Conclusions—Of the colour reactions described by Denigès, only the ones with codeine and with phenyl salicylate are sufficiently specific for the detection of glycerol in sized cloth. Phenyl salicylate gives the more distinctive reaction, the colour being very intense and not readily masked. The greenish-blue colour given by codeine is very easily masked by a trace of brown, and the test is nullified in this way if "Solution G" contains a trace of organic matter which is charred by sulphuric acid.

QUANTITATIVE

An attempt has been made to estimate small quantities of glycerol in cotton goods by the "I.S.M." acetin process,[5] the glycerol being extracted from the cloth and freed, as far as possible, from substances likely to interfere, exactly as described above under "Benzoylation Test."

The work was undertaken originally in order to find a means of estimating glycerol in comparatively heavily sized cloths, containing from 1% to 3% of glycerol. The method tried and here described will estimate glycerol in such cases with fair accuracy. Attempts to adapt the method to the analysis of lightly sized cloths, containing from 0·1% to 0·5% glycerol, have not been successful, the amount of glycerol found being always much too high. This is attributed to the presence, in the final glycerol extract, of the substance which has been noted above to form an oily benzoate, and which, as may be expected, acetylates along with the glycerol. If a sample of the particular unsized yarn is available, this difficulty may, of course, be obviated by means of a "blank."

Apart from this, however, it is considered that the acetin method is unsuitable for the estimation of glycerol in such small amount. The final titration is performed in a large volume of solution containing a considerable quantity of sodium acetate, and the end-point is not sufficiently sharp to ensure accuracy. Throughout the work the amounts of acetic anhydride and fused sodium acetate used have been those recommended in the "standard method." It was not considered advisable to reduce these, in spite of the very small quantity of glycerol present in an estimation, since it is difficult to free the extracted glycerol from water without losing glycerol by over-evaporation.

Experimental

A number of cloths, sized with known mixtures, were used to test the method. In each case the total amount of size on the cloth was determined experimentally, using a modification of the method described by Bean.[6] The percentage of glycerol in the cloth was then calculated from the known composition of the size. The figures thus obtained are necessarily approximate only, since average figures have had to be used in allowing for differences in moisture content of sizing ingredients in the raw state and on the cloth.

As stated above, the glycerol was extracted from the cloth and purified as described under the benzoylation test. The final neutralised solution thus obtained was evaporated *in vacuo* on the water-bath until practically all the salt had separated out and the crystalline mass remained only just moist. Particular care had to be taken not to carry the evaporation to absolute dryness. This final evaporation was carried out in the flask in which the acetylation was to be performed. In a few early experiments the glycerol was separated from the salt residue by washing several times with a mixture of alcohol and ether. This was found to be unnecessary, having no effect on the amount of glycerol found. The results of a number of typical estimations are given in Table I.

Table I.

Sample	Amount of Size on sample	Wt. of Sample analysed	Amount of Glycerol on sample: Calculated	Found
Cloth A	38·5%	8·5 grams	2·75%	2·71%, 2·64%
Cloth B	11·6%	15 ,,	0·90%	0·98%, 0·98%, 0·99%
Cloth C	18·7%	15 ,,	1·58%	1·63%, 1·65%, 1·65%
Cloth D	33·2%	7 to 8 ,,	2·38%	2·42%, 2·34%, 2·41%, 2·43%, 2·38%
Cloth E	5·1%	40 ,,	0·20%	0·29%
Yarn A1	10·2%	20 ,,	0·40%	0·49%, 0·49%, 0·48%, 0·49%
Yarn E1	16·0%	35 ,,	0·31%	0·41%
Some unsized American yarns	...	...	...	0·13%, 0·15%, 0·06%, 0·12%

SUMMARY AND CONCLUSION

(1) Glycerol in sized cloth or yarn may be detected by suitable purification of an alcoholic extract of the sample and characterisation of the glycerol by the formation of a crystalline glyceryl benzoate, m.p. 72–73° C.

(2) A further method of identification of glycerol is by means of certain of Denigés' colour reactions.

(3) The "I.S.M." acetin method may be used to estimate glycerol in cotton goods, with fair accuracy, if the amount present exceeds 1% of the weight of the sample, but the method is not suitable for the estimation of glycerol in pure-sized goods, where the percentage is much less than 1%.

The author's thanks are due to Messrs. Boardman & Baron, Ltd., of Great Harwood, in whose laboratory the work was carried out, for permission to publish the results of this investigation.

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19—THE EFFECT OF SIZES ON THE ELASTIC BEHAVIOUR OF FLAX YARNS*

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PART I.

INTRODUCTION

An investigation has been carried out on the effect of various sizing ingredients on flax yarns used as warps in weaving. The primary object was to obtain a quantitative estimate of the effect of various sizes and ingredients on the elastic behaviour of the yarn, but at the same time some attention was paid to the resistance to rubbing of the sized yarns.

In preparing warp yarns for the loom, they go through the processes of winding and beaming, and then dressing, which briefly comprises the passage of the yarn through a size trough, drying by passage over a hot air chamber, and when dry, winding on to the weavers' beam. Tallow is sometimes applied to the dried yarn. The object of the applied dressing or size is stated to be to lay the hair or loose fibres on the surface of the yarn, thus reducing friction in the shedding and facilitating the weaving operations. That is, the sized yarn should have a smooth surface able to resist the friction experienced at various places during its passage through the loom.

It appears to be generally recognised that the addition of the usual sizing mixtures reduces the elasticity of the yarn, at the same time increasing the breaking strength. There appear, however, to be very few data published on the quantitative effect of the size in reducing the elasticity. The experiments to be described were undertaken in order to study sizes and sizing materials as an aid to weaving efficiency alone. The question of the use of sizes in order to produce certain finishes involves entirely different conditions.

CONSIDERATION OF FACTORS DEFINING WEAVING EFFICIENCY

A good-weaving warp yarn may be defined as one which will pass through the loom without breaking or being unduly weakened, and without presenting a frayed appearance, as this would militate against a good finish in the completed fabric. Three physical factors are usually mentioned in connection with the effects of sizes, and these are—

(*a*) Weight of size on the yarn.
(*b*) Strength of the sized yarn.
(*c*) Elasticity of the yarn.

In connection with this investigation, the *weight of size* did not appear to be very important; the view taken was that so long as the size was evenly applied and not excessive in quantity, the exact amount was immaterial so long as it enabled the yarn to withstand the friction on the loom.

* This and the foregoing paper, No. 18, were read at a meeting of the Lancashire Section of the Institute on 12th February. The discussion following the reading of these papers appears on pages T206-T212.

The *breaking strength* is undoubtedly an important factor and one which is well recognised. The effect of the usually employed size mixtures is to increase the breaking strength. Since the friction on the loom is, in the case of maximum efficiency, to be entirely absorbed by the dressing, it should be possible for the yarn itself to go through the weaving process without loss in strength. That is, if the yarn after passage through the loom was desized and tested, its strength should be the same as before sizing. If, however, the sized yarn were tested after emerging from the loom, its strength would show a decrease,[1] but unless this strength is less than that of the yarn before sizing, it need not necessarily follow that this yarn if desized would be weaker than before sizing.

The *elasticity* of the yarn must be an extremely important factor in weaving, where the applied stresses are varying so rapidly. The term elasticity is very often erroneously used to mean the elongation at break, whereas its real meaning, applicable as long as Hook's Law is obeyed, is the amount of stress per unit strain, where the strain is the actual stretch divided by the original length. When samples are tested in comparison, the samples being of the same weight per unit length, and the same length, this definition of elasticity becomes equal to the applied load required to produce unit stretch. That is, it is a measure of the rate of stretching with load. It is therefore necessary to consider the behaviour of the yarn at all stages during the application of the load, and in these experiments this has been done, in addition to noting the more usually measured elongation at break.

In order to be able to compare quantitatively the probable behaviour of various yarns, a single figure is required which takes into account variations in strength and elasticity, as both must be taken into account. Now it has been found in all cases of sized, boiled, flax yarns, that the relation between load and stretch is almost exactly represented by a straight line. Consider the cases represented in Diagram 1. The lines OA and OB show how the yarns A and B stretch according to the amount of load applied, and mean that B stretches more easily than A. If both have the same breaking strength OX_0, then BX_0 and AX_0 represent the elongations at break of B and A respectively, and so in this case the elongation at break would serve as a measure of the elasticity of the yarn, but this is only true when the breaking strengths are equal. For example, if yarn A had a breaking strength OX_1, then the elongation at break would be $A_1X_1 = BX_0$, and in this case the elongation at break would not serve to differentiate between A and B as regards elasticity. Also we see from this diagram that when the elasticity is constant for different samples, then the elongation at break and breaking strength are proportional. From such a diagram, however, a figure combining varying elasticity and breaking strength can be evaluated, which is the *work to break*, or the amount of energy which must be expended to break the yarn. Consider Diagram 2. The lines OA and OB represent the stretch at every stage of applying load up to the breaking point, as before. The area OBD represents the sum of the products of load by extension at every stage, and is therefore a measure of the work done up to the breaking point. In the cases of sized flax yarns OA and OB are practically straight lines, so the areas can be calculated from the product of half the breaking load $\times$ elongation at break. In the case of an unsized yarn, the area becomes similar to OCF, which cannot be so simply calculated, but the area can be measured by means of a planimeter. This *work to break* therefore now allows of a comparison

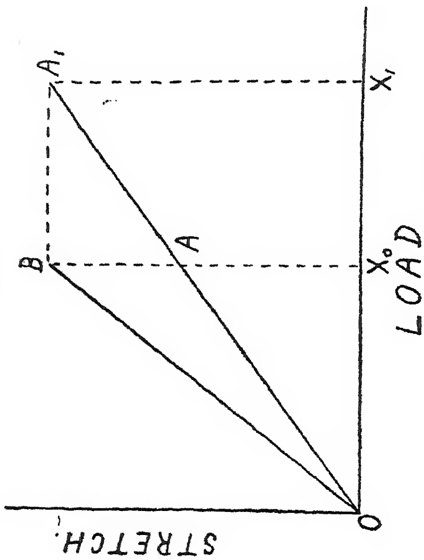

DIAGRAM 1

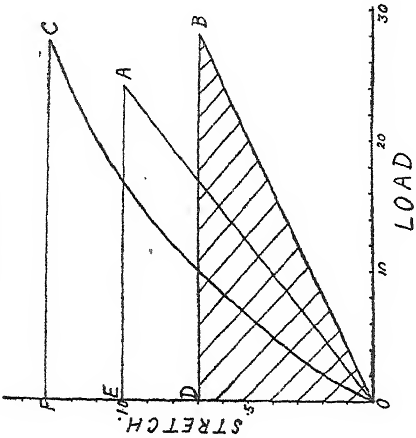

DIAGRAM 2

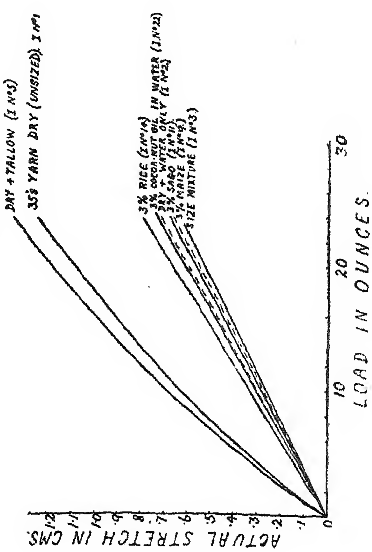

DIAGRAM 3

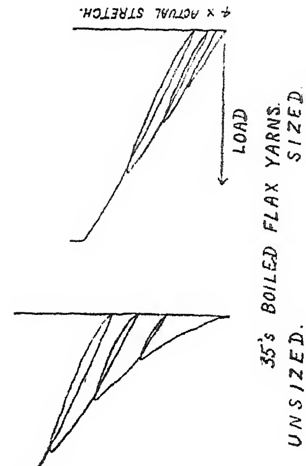

DIAGRAM 4

between samples of different strengths and elasticities. Thus, yarn A is weaker than B, but it stretches more readily or is more elastic than B. Calculating the respective works to break we get—

Work to Break

$$A = \tfrac{1}{2}\ AE \times OE = \tfrac{1}{2}\ 24 \times 10 = 120$$
$$B = \tfrac{1}{2}\ BD \times OD = \tfrac{1}{2}\ 29 \times 7 = 101{\cdot}5$$

from which it would be concluded that yarn A would give the better result in working, although B has the greater breaking strength. This clearly shows the advantage of increasing the elasticity so far as efficiency of working of yarn in weaving is concerned. To sum up this theoretical survey of the conditions affecting the efficiency in weaving of sized yarns, it may be concluded that—

(1) The function of the size is to give the yarn a smooth surface which enables it to pass over the loom without loss in strength or presenting a frayed appearance.

(2) Whilst measurements of breaking strength or elongation at break may be helpful in considering the behaviour of the yarn under working conditions, they do not alone suffice.

(3) A measurement of the work to break gives an indication of the behaviour of the yarn under working conditions, as it combines the effects of strength and elasticity. This necessitates a knowledge of the behaviour of the yarn in stretching under loads at all stages up to the breaking point.

(4) The importance of having the elasticity as great as possible is indicated.

EXPERIMENTAL

In making a study of the efficiency in weaving of sized warp yarns, it appeared desirable to determine the elastic behaviour of yarns dressed with ordinary mixtures, and also with a variety of ingredients alone, with the ultimate object of preparing mixtures which would give the maximum possible elasticity to the sized yarns compatible with sufficient strength and resistance to friction. Dressings were prepared in the laboratory and applied in the usual way on the dressing machine, the felt covers on the roller being carefully cleaned between each sample. Only a few strands were sized at a time, and only enough prepared for the necessary tests to be made. In this way a small stock of yarn originally wound on to a number of spools sufficed for the whole investigation; the same yarn then was used throughout, and being fairly small in quantity, variations in the quality of the yarn were eliminated as far as possible. The dressings were prepared in various groups, such as starches, softeners, &c., about eight samples to each group. In this way direct comparison could be obtained between the effects of the members of each group, atmospheric effects on the test results being eliminated as far as possible by conditioning together and testing in rotation.

With every set of dressings tested, a sample of the undressed yarn was put through the dressing machine, exactly in the same way but with the size trough empty. The object of this was to give the undressed yarn the same tension effects, and by using this sample as a control for the set, the effect of the addition of the size alone should be obtained. The results are tabulated, but in order that samples in one set may be directly compared with samples in any other set, prepared and tested at different times, the actual results are not quoted, but the results expressed as a percentage of those of the control for the set.

All samples were allowed to condition for one week in the laboratory before testing, and records were made of the lea, breaking strength, elasticity, the appearance and feel, and the resistance to rubbing. The *breaking strength* was determined on a Mulholland Yarn Tester, 100 breaks being taken in each case. The *elasticity* measurements were made on the machine already described by the author.[2]

The yarn employed was a 35's boiled yarn of very good quality.

In this investigation the following procedure was adopted. The rate of loading was kept constant at 22 ounces per minute throughout; this rate is quite slow compared with actual working conditions, but faster than previously employed. A slow rate of loading is beneficial in testing, as it is found that very consistent results can be obtained from a small number of tests.

Twelve lengths (30 inches) of each sample were tested, and an autographic record obtained of the load-stretch diagram. Each drum chart allowed room for three diagrams, so three tests were made of each sample in rotation, and all sequences were completed when once started. From these curves, the elongation at break and breaking strength were noted, and by averaging the various loads at certain extensions, a mean load-stretch diagram for the sample was constructed. These mean curves can then be plotted on the same diagram for comparison, but for purposes of tabulation, the elongation at some arbitrarily selected load was noted. Since the test length remains constant and the lea of the yarn is also constant, except for small variations due to varying amounts of size taken up, this figure serves as a convenient measure of the rate of stretching of the yarns under these conditions. This load was fixed at 20 ounces, being about two-thirds of the mean breaking strength, and so allowing a good margin for variation in strength of the various samples.

In addition, some further tests, three on each sample, were made in which the yarns were alternately loaded and unloaded as described in the previous paper,[2] from which mean values were determined of the ratio of Total/Permanent stretch, and hence of the percentage of elastic in the total stretch.

The *resistance to friction* was tested in a qualitative manner, on a small machine designed for the purpose. A qualitative test, that is, one in which the yarn is subjected to a fixed amount of rubbing, and its appearance examined visually, appeared on consideration to be all that was necessary for the purposes of this investigation. It has the advantage that when once the desirable amount of rubbing has been determined, samples can be tested in a short time. There are two methods of making a rubbing test quantitative—

(1) To count the number of rubs before break occurs;
(2) To subject the yarn to a fixed number of rubs; and to determine the loss in breaking strength.

Such tests necessitate a more complicated machine and involve much more time. In the first case, it gives no information on the appearance of the yarn after rubbing, which, as was pointed out in an earlier section, is probably one of the most important and desirable features in a size; in connection with the second case, it has been pointed out that strength tests on sized yarns after rubbing do not necessarily give an indication of the effect of rubbing on the strength of the yarn itself.

The machine used was fitted up to attempt to produce in a small way the rubbing to which yarn is subjected in weaving. The actual conditions

can, of course, only be obtained in a loom, but for experimental purposes where comparative work only is in question, the actual conditions are not so important, so long as they are sufficiently severe to produce a good fraying effect on an unsized yarn and leave sufficient range for judging the effects on various sizes.

The machine consisted of a bobbin containing the yarn, tension being applied by a leather brake acting on the rim of the bobbin, a rocking arm carrying a set of reed pins in a frame on the end, and a second bobbin for winding up the yarn. The rocking arm and take-up bobbin were geared together, and the whole machine driven by a belt from a shaft or electric motor, so that the speed of the yarn and the number of oscillations of the rocking arm represent those experienced in an average loom. Besides the friction between the reeds and the yarn, other rubbing surfaces were introduced, such as wooden bars to represent the lease rods, a piece of a heddle suspended from a spring and kept tight by a hanging weight, and a curved iron surface for the yarn to rub over in changing from the horizontal to the vertical before reaching the take-up bobbin. By suitably arranging the tension on the yarn, and the path through the machine, which chiefly affects the angle of the yarn around the reed pins, a large variation can be obtained in the amount of friction experienced by the yarn. The conditions were arranged by trial so that an unsized boiled yarn was considerably frayed, but a sized yarn, dressed with a mixture known to give satisfactory results in practice, showed little or no effect after rubbing. These conditions were then adopted as a standard for the series of tests to be made. Specimens of each sample, before and after rubbing, were then mounted side by side on a black card which renders visual examination of the appearance very easy.

The experiments were designed to cover the following main headings—

(i.) A compound size mixture and the effect of tallow.
(ii.) Various starches and varying strengths of paste.
(iii.) Gums in equal strength solutions.
(iv.) Softeners (including deliquescents) as solutions or emulsions in water, of constant strength.

The effect of friction was only tested on the samples under the first three heads. The results are tabulated in Table I. and some results are shown graphically and will be referred to in detail later.

Discussion of the Results in Table I.

Appearance and the Resistance to Rubbing—In this series the Size Mixture No. 3 was regarded as a standard, as it was known to give satisfactory results on a loom. It appears that water alone adds slightly to the resisting power as it causes a hardening of the yarn, but the chief factor in causing resistance to rubbing is the sizing material added. If these results may be taken as truly representative, it would appear that tallow added as an external layer reduces the effect of rubbing on an unsized yarn (No. 5), but slightly increases this effect on a sized yarn (No. 4). A possible explanation may be that the tallow softens the size layer and so allows abrasion to take place more easily.

Of the various starches, the appearance before rubbing appeared to be best with maize, with sago, potato, and rice next in order. Varying the strength of the paste made no striking differences. The resistance to rubbing appeared also to be in the same order, with rice distinctly the worst. There was an indication that increasing the strength of the paste increased the power of resistance to the rubbing.

Table I.

(1) Test No.	(2) 35's Lea Boiled Yarn Treated on Dressing Machine	Strength and Elasticity: (3) Breaking strength, Comparative	(4) Per cent. Elongation at Break, Comparative	(5) Work to Break, Comparative	(6) Elongation under 20 oz. Load, Comparative	(7) Ratio of Total/Permanent Stretch	(8) Per cent. Elastic in Total Stretch	(9) Increase in Weight by Dressing, per cent.	Appearance: (10) Before Rubbing	(11) After Rubbing
	I.—*Compound Size Mixture and Effect of Tallow*									
1	Dry (no size)	100	100	100	100	1·91	47·6	—	Very soft and hairy	Much worse than before rubbing.
2	Cold water only	116	71·2	82·6	54·8	2·76	63·9	—	Harder and less hairy than No. 1	Very hairy but not so bad as No. 1.
3	Size mixture without tallow	131	72	94·2	48·5	3·94	74·7	6·9	Wiry and smooth	No change.
4	Size mixture with tallow	115·7	64·3	74·5	49·5	4·79	79·1	9·1	,, ...	Hair very slightly raised.
5	Dry (no size) with tallow	114·6	71·0	81·4	109	1·77	43·5	5·0	Soft and hairy	Very hairy, about same as No. 2.
	II.—*Variety and Strength of Starch*									
6	5% Potato starch paste	116	66·5	77·2	50	2·86	65	—	Dull looking but crisp feel, hair not laid.	Very slight effect.
7	3% ,, ,, ,, ...	113	69·6	78·7	54·6	4·2	76·2	5·5	,, ,, ,,	,, ,,
8	5% Maize ,, ,, ...	106·2	63·4	67·3	52·8	3·6	72	3·2	Very good, firm and smooth ,, ...	No effect. ,,
9	3% ,, ,, ,, ...	113·6	65·2	74·1	50·7	3·58	72	4·4	,, ,, ,, ...	,,
10	5% Sago ,, ,, ...	116·2	70·2	81·6	54·6	3·11	67·9	6·4	Good, next to 8 and 9, not so crisp	Some fraying.
11	3% ,, ,, ,, ...	112·6	65·9	74·3	52·1	3·37	70·4	5·1	,, ,, ,,	Very hairy.
12	1% ,, ,, ,, ...	108·4	69·6	75·5	57·3	3·7	73	3·2	,, ,, ,,	,,
13	5% Rice ,, ,, ...	112·4	64	71·9	50·0	4·49	77·7	7·4	Dull looking, not crisp. Hair not laid	Slightly frayed.
14	3% ,, ,, ,, ...	113	76·4	86·3	61·3	3·24	69·0	4·2	,, ,, ,,	,, rather worse.
15	3% Sago (applied and tested at different time to No. 11)	110	65	71·5	50·6	3·05	67·2	5·7	Wiry and smooth	Slightly hairy.
	III.—*Other Adhesives*									
16	1% Gum tragon	112·5	70·2	79·0	52·2	3·4	70·4	—	Very firm and fibre well laid; almost polished appearance.	No effect.
17	2% ,, ...	121·2	73·0	88·5	50·2	4·78	79·0	—	,, ,, ,,	,,
18	2% Dextrin	119·4	62·9	75·1	44·6	3·86	74·0	—	No improvement on unsized ,, ...	No more resistance than unsized
19	2% Glucose	95·5	61·3	58·6	53·7	3·48	71·2	—	,, ,, ,,	,, ,,
20	2% Quellin (soluble starch)	121·6	65·8	80·0	45·5	4·75	78·9	—	Slightly firmer, but still hairy ...	Some fraying.
21	2% Irish moss	118	66·9	78·9	44·5	4·66	78·4	—	Fibre well laid, firm, and springy	Frayed more than No. 20.
	IV.—*Softeners and Deliquescents in Water*									
22	3% Cocoanut oil emulsion	101·8	66·6	67·8	56·3	2·5	60	—		
23	3% Tallow emulsion	111	65·9	73·1	51·2	4·24	76·5	—		
24	3% Hardened whale oil emulsion	111	70·6	78·4	55·0	4·49	77·9	—		
25	3% Oleine oil solution	97·4	61·2	59·6	54·7	5·28	61·2	—		
26	1% Soap solution	103·4	57·1	59·0	47·5	3·23	69	—		
27	3% Glycerine solution	115·4	65·3	75·3	49·5	4·08	75·4	—		
28	3% Calcium chloride solution	110·2	67·7	74·6	53·8	4·08	75·4	—		

In Section III., gum tragon gave a very good appearance and a total resistance to rubbing, and therefore appears as good as maize starch, although in much weaker solution. A deciding factor, if other considerations such as strength and elasticity were also equal, would be the relative cost of these two materials. Irish moss gave a yarn of very good appearance, but the resistance to rubbing was very poor. The other materials used in this section all gave poor results, both as to initial and final appearance.

An estimate of the *amount of size* taken up by the yarn is given in Column 9. The measurements were made on about 50-yard samples, and generally appear to be concordant, except in Nos. 8 and 9, which may be explained as due to yarn variation, but more probably, since the yarn was of good quality, may be due either to an anomalous behaviour of the rollers on the dressing machine or to some effect connected with the extremely high viscosity of such pastes as 5% potato and maize starches. Comparison of Nos. 3, 4, and 5 show that a sized yarn only takes up about half as much tallow, applied from a brush, as an unsized yarn; this is probably a penetration effect. In the cases of sago and rice, the amounts of size taken up are in the same order as the strengths of the paste. Repeat experiments with 3% sago (Nos. 11 and 15) gave very similar figures.

The *breaking strengths* are given in Column 3. Only in two cases (Nos. 19 and 25) were the treated yarns weaker than the dry yarn; Nos. 22 and 26, both softeners, gave only slight increases, whilst the remainder were all decidedly stronger than the dry yarn, with the Size Mixture No. 3 giving the strongest yarn. Except for the four samples first mentioned, the strengths show only slight differences from that of the yarn treated with cold water alone. The addition of tallow to the Size Mixture No. 3 appears to cause a decided reduction in strength.

The *elasticity* is recorded in several ways, as follows—

(*a*) *Load Stretch Diagram*—The mean load stretch diagram for the dry (unsized yarn) is, as shown in Diagram 3, distinctly curved. Except for No. 5, the dry yarn treated with tallow, all the other tests recorded in Table I. gave graphs which were indistinguishable from straight lines, and a number of typical cases are also shown on this diagram. For this reason the values quoted in Column 6 for the elongation at 20 ounces load give a strict comparison of the rate of stretching of the yarns under these conditions of loading. It will be seen that, considering the wide variety of materials used, there is a surprisingly small variation in the rate of stretching of the treated yarns, the extreme values being 44·6–61·3, with the majority between 50–55, and cold water only giving a value of 54·8. These results show therefore that in all these cases the rate of stretching of the sized yarns is only about one-half of that of the unsized yarn.

(*b*) *Per Cent. Elongation at Break*—These figures again show only a small range of variation for all the materials tested, which, of course, follows from the results mentioned above, because both the breaking strengths and rate of stretching have been seen to be fairly uniform.

(*c*) *Work to Break*—These figures are deduced from the area on the load stretch diagrams included between the graph and the ordinate or elongation scale, as mentioned in an earlier section. The values for the dry yarns (Nos. 1 and 5) were obtained with a planimeter, but in the other cases, since they gave practically straight lines, the values were calculated from half the product of breaking strength and elongation at break. Here again

the variation is not striking, and in every case the work to break is less for the sized yarns than for the dry yarn (unsized), No. 1. The Size Mixture No. 3, without tallow, gives decidedly the highest value, because of its outstanding breaking strength, but most of the starches and other adhesives gave values almost identical with the dry yarn treated with water only (No. 2). Several of the softeners also gave values as high as the starches and water, but oleine oil and soap solutions gave low values because of the low breaking strengths in these cases.

(*d*) *Ratio of Total/Permanent Stretch*—A very pronounced difference is shown between a sized and an unsized yarn, for which typical loading and unloading curves are shown in Diagram 4. The value of the ratio obtained from sized yarns is very high, and it is obvious from the diagrams that this is due to the comparatively small amount of permanent stretch obtained on unloading a sized yarn. Here again, however, only a comparatively small difference is obtained between the majority of the sizes tested, compared with the difference between sized and unsized yarns. The tallow added to the dry yarn (No. 5) gives rather a lower figure than the dry yarn, whilst cold water only gave a value about mid-way between those for the dry yarn and the majority of the other sized yarns.

(*e*) *The Per Cent. of Elastic in Total Stretch* is given in Column 8, and is obtained from the values in Column 7 as explained in the previous paper.[2] It will be seen that, as a consequence of the high ratio of total/permanent stretch, a sized yarn gives a much greater amount of recoverable stretch than an unsized yarn or an unsized yarn treated with tallow, but the interesting point again is that the actual difference in amount does not appear to be very greatly affected by the nature of the sizing material.

CONCLUSIONS

From the results of the tests recorded in Table I., the following conclusions may be made—

(1) The nature of the sizing material considerably affects the appearance of the yarn, and the materials differ considerably in their power of resisting rubbing, such as is experienced on a loom.

(2) The elastic behaviour of a sized yarn differs considerably from that of an unsized yarn, the load stretch curve is different in type, and the rate of stretching is very different. The nature of the loading and unloading diagrams also differ considerably, leading to a much higher value for the ratio of total/permanent stretch and of the per cent. of elastic in the total stretch for sized yarns, compared with unsized yarns.

(3) The elastic behaviour of a dry yarn treated with tallow alone from an ordinary tallow brush is similar in characteristics and amounts to the dry yarn.

(4) With small exceptions, no essential difference is found in strength and elastic behaviour between a yarn sized with a very wide range of materials including various starches, other adhesives and softeners and deliquescents applied with water, and water only.

The combined effects of conclusions (3) and (4) are of particular interest in connection with the objects of this investigation, showing briefly that the nature of the sizing material added to water, whether starch, gum, or softener, does not essentially and only in a slight manner, quantitatively, alter the effects of treating a yarn with water alone, as regards the strength and elasticity.

The original object of the investigation has therefore been answered, but not in the manner anticipated, as it is shown that no really significant alteration in the elastic behaviour and therefore in the efficiency of the sized yarn on the loom can be expected by any variation in the nature or proportion of the ingredients of the size; alteration of the size mixture, however, may be expected to affect the other essential of a size, namely, the resistance to rubbing.

PART II.

In the above it was shown that the elasticity of a boiled flax yarn is reduced by approximately 50% by the usual method of sizing. Some further experiments were then carried out to determine the cause of this reduction, since it was conclusively shown not to be dependent on the nature of the size. The similarity of the results from the 28 tests recorded in Table I., excepting Nos. 1 and 5, appeared to indicate that a common influence was acting on the yarns in all cases. Consideration of the experimental conditions apparently limits this influence to one or both of two factors, namely—

(1) The presence of water as a main constituent (about 95%) of the size.

(2) Some condition experienced on the dressing machine, the most probable appearing to be the tension on the yarn. Evidence that the first factor is involved is obtained from the tests, Nos. 1, 7, and 25, in Table I. In No. 27, tallow was applied as an emulsion in water, and the resulting sized yarn had elastic properties similar to all the other sizes containing starch, &c.; in No. 7, tallow was applied neat and the treated yarn had elastic properties similar to that of the dry (unsized) yarn. The only difference then in the treatment of Nos. 7 and 27 was the presence of water in the dressing.

Evidence that the tension on the sized yarn on the dressing machine may be important is obtained from a consideration of the great difference in value of the ratio of total/permanent stretch of sized and unsized yarns. As mentioned above, it is obvious from the loading and unloading diagrams shown in Diagram 4 that the difference arises from the small permanent stretch shown on unloading the sized yarn, compared with that shown on unloading the unsized yarn. This small amount of permanent stretch may be due, either (1) to an adhesive action of the size preventing slipping of the fibres past one another and tightening up of the fibres on one another during the loading, which is assumed to be the cause of the permanent stretch in an unsized yarn, or (2) to a large amount of the permanent stretch of the unsized yarn having been brought about during the sizing operation, such as by tension on the sized yarn in its wet state, the subsequent drying of the sized yarn under tension preventing its recovery.

Owen, in a paper on "Some Physical Tests of Sized Yarns,"[3] from measurements of extensions produced on sized and unsized cotton yarns by oscillations of tensions, found striking qualitative differences in behaviour which were interpreted as indicating a cementing action of the size, and the apparent equality of different sizings were explained on the assumption that in all cases the cementing action was complete, or in the average nearly so. Owen, therefore, under entirely different experimental conditions, arrived at the same conclusion as was drawn in Part I. of this paper, and adopted the first of the above explanations. His experiments, however, were confined to the effect of various starches, and this explanation does not seem so probable from the results given in Table I. as the same effect as with starch

and other adhesives is also found with water only and with water mixed with softeners, such as cocoanut oil, tallow, glycerine, &c.; on drying of the yarn the cocoanut oil, tallow, &c., alone would be left, and these would possess no adhesive power. It appears therefore from the above more general investigation that explanation (1) is not likely to be the controlling factor, so we are left to conclude that explanation (2) is the more probable.

It was concluded therefore, from consideration of all the available data, that the factors which caused the reduction of elasticity of the sized yarns

Table II.

(1) Test No.	(2) 35's lea Boiled Yarn	(3) Breaking Strength, Comparative	(4) Per cent. Elongation at Break, Comparative	(5) Work to Break, Comparative	(6) Elongation under 20 oz. Load, Comparative	(7) Ratio Total/Permanent Stretch	(8) Per cent. Elastic in Total Stretch
1	Dry (no size)	100	100	100	100	1·85	46
	Treatment under Tension without Water						
2	Cocoanut oil	94·1	97·7	92·0	102	1·8	44·4
3	Hardened whale oil ...	77	78·5	60·4	92	1·95	48·7
4	Tallow	85·9	87·2	74·8	93·5	2·05	51·2
5	Glycerine	103·5	112·1	116·2	110	2·08	52·0
6	Trotter oil	93·8	97·7	91·5	105	1·94	48·5
7	Alcohol	95·7	78·5	75·0	76	2·63	62·0
	With and Without Tension						
8	Cold water, rubber stripper 16 oz. tension	116	71·2	82·6	69·4	2·61	61·8
9	Cold water, soaked only, no tension	118·4	97	114·8	94	1·65	39·4
10	Size mixture (No. 3 of Table I.), soaked only, no tension	120·4	85·3	102·7	82·7	2·04	51·0
11	Tallow, rubber stripper, same setting as No. 8, tension 3 oz.	90·5	73	66·0	87·8	2·16	53·7

were the presence of water as a main ingredient of the size and/or the tension applied to the yarn on the dressing machine. The data were not sufficient to decide whether either alone or both together were necessary to produce the effects, so further experiments were made to decide this point. The measurements were confined to those of strength and elasticity, and the results are given in Table II.

These experiments were carried out in the laboratory and the yarns were not treated on the dressing machine, as before. The yarns were passed through a trough containing the dressing and then slowly pulled through a clamp between two pads of rubber which served the purpose of removing excess material and applying tension to the yarn. The yarns were then wound into hanks and dried on a pole in the laboratory. The conditions were therefore somewhat different from those existing on the dressing machine, as there the tension was maintained whilst drying was carried out. In each series of samples, the pressure on the rubber pads was maintained constant, but it was found that the tension on the yarns differed

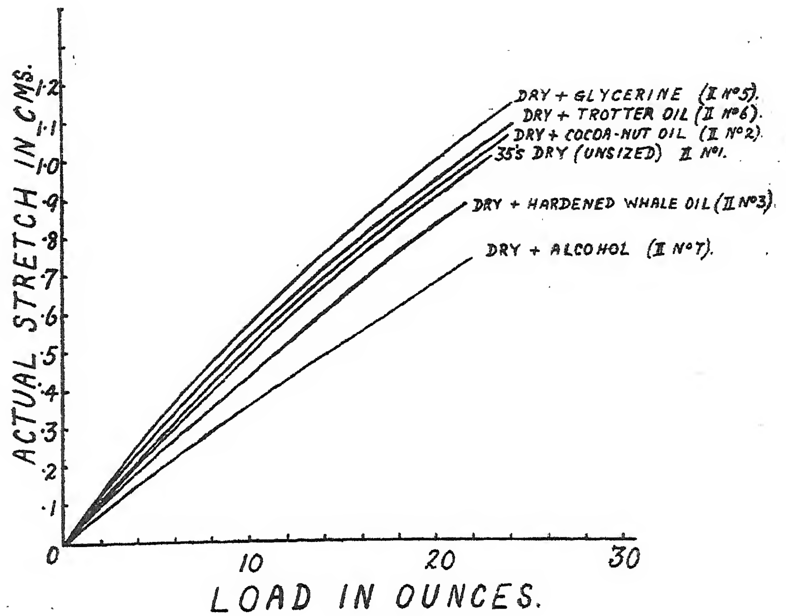

DIAGRAM 5

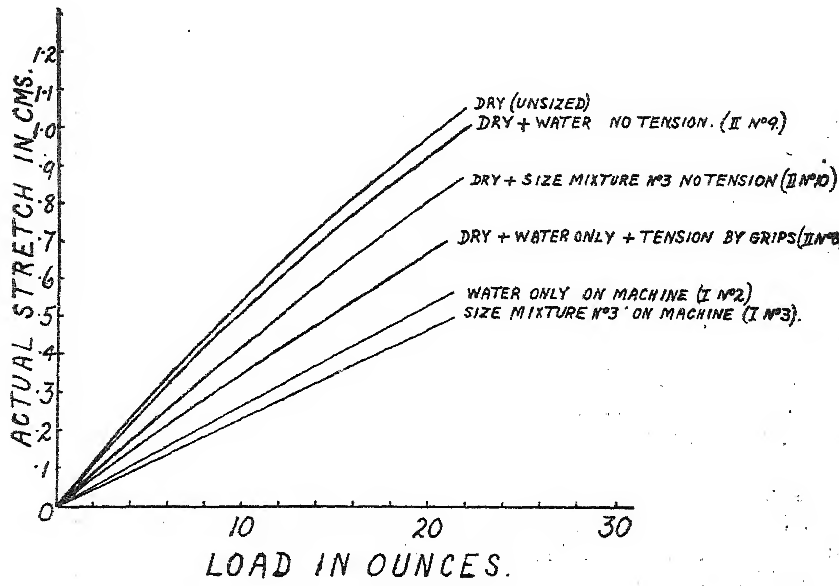

DIAGRAM 6

owing to the variation in lubricating power of the different materials. A dry (unsized) yarn was pulled through for comparison as before.

Tension in the Absence of Water

The first set of samples examined (Nos. 2–7) were treated with some of the softeners used in Table I. (also alcohol and trotter oil), but this time applied alone, so we get the condition of tension in the absence of water. It will be seen that glycerine (No. 5) slightly increases the strength and decidedly increases the rate of stretching, so the work to break is also markedly higher than that of the dry yarn. All the other samples showed a decrease in strength of varying amounts. The rate of stretching was greater than that of dry yarn in the cases of cocoanut oil (No. 2) and trotter oil (No. 6); hardened whale oil (No. 3), and tallow (No. 4) each showed a slight decrease. The work to break varied considerably according to the breaking strengths. The results for the ratio of total/permanent stretch in these cases were all very nearly equal to that of the dry yarn. The yarn treated with alcohol behaved quite differently from the others, showing a marked decrease in the rate of stretching, consequently a very low work to break, an approximately linear relation between stretch and load typical of ordinary sized yarns, and a ratio of total/permanent stretch considerably higher than that for the dry yarn.

The mean stretch-load diagrams are shown for these samples in Diagram 5. It is evident from these curves and the results mentioned, that in this set yarn treated with alcohol under tension has given results almost typical of an ordinary sized yarn, but in all the other cases, in which the dressings were applied under tension but in the absence of water, the elastic behaviour of the yarns are of the same type and quantitatively of the same order as for the dry unsized yarn. It appeared therefore that the presence of the water in sizes was necessary in order to produce the reduced elasticity found.

Tension in the Presence of Water

A further set of samples was prepared to determine the effect of tension in the presence of water. The mean load-stretch curves are shown in Diagram 6, with the addition of the curves for water only and Size Mixture No. 3 from Table I., to give a direct comparison with results from the dressing machine. In order to make Nos. 2–7 comparable with the behaviour of samples treated with water under the same conditions, one of them, tallow, was repeated, using the same conditions as for the water treated samples Nos. 8–10. Comparison of Nos. 4 and 11 therefore would indicate the relative applied tensions in the two experiments; the rate of stretching is lower in No. 11, and the ratio of total/permanent stretch is also a little higher, so it would appear that the tension on samples 8–11 was rather higher than in samples 2–7.

Comparison of No. 8, Table II., with No. 2, Table I., both for cold water alone, serves to connect the conditions in these experiments with those on the dressing machine. It will be seen that the results are very similar, the chief difference being in the rate of stretching. It would appear therefore that the laboratory conditions of applying these dressings produces results very similar to what would have been obtained on a dressing machine.

In No. 9 the yarn was soaked in cold water for a few minutes and dried on a pole, so no tension was applied. Comparison with No. 8 therefore shows the effect of tension only. The strengths of the two yarns were equal and greater than the dry yarn, but the yarn treated without tension gave results

for elasticity only very slightly less than those for the dry yarn, and consequently the work to break was very much higher than for dry yarn.

A similar test was made with the Size Mixture No. 3 of Table I., applying the size by soaking the yarn in the size and drying on a pole without tension. The strength was only very little higher than for the yarn treated with water only; the rate of stretching was decidedly lower than that of dry yarn, but the work to break still remained slightly greater than for dry yarn. The ratio of total/permanent stretch was slightly higher than that for dry yarn, but rather lower than for a pure tallow dressing applied under tension. Comparison of the figures for No. 10 in Table II. with those for No. 3 in Table I. shows the effect of tension only in the case of a size mixture, and it will be seen that the results of Nos. 8 and 9 with water only are fully confirmed.

Conclusions

It appears therefore from these results that tension must be applied to the water-treated yarn in order to produce the 50% reduction in elasticity found with ordinary sized yarns. The addition of water alone without tension produces a very slight reduction in elasticity, probably due to a binding action on the fibres; the addition of starch paste without tension gives a rather greater reducing effect on the elasticity than water alone, which probably indicates the true effect of adhesion due to the starch, but the behaviour is still typically the same as a dry (unsized) yarn. It is concluded therefore that the major cause of the small elasticity of sized flax yarns, compared with unsized, is the tension applied to the yarn on the dressing machine after wetting by the water in the size mixtures, only a relatively small effect being attributable to real adhesive effects of the starch or other adhesive ingredient.

The writer wishes to thank the Directors of the York Street Flax Spinning Co. Ltd. for permission to publish these results.

SUMMARY

As a result of an investigation of the sizing of flax warp yarns, including a large variety of the usual sizing ingredients, it is shown that the elasticity of a sized yarn is approximately only half of that of an unsized yarn, and that the behaviours on stretching are quite different, as is demonstrated by stretch-load diagrams. It is concluded that whilst the nature of the various ingredients will considerably affect the appearance of the yarn, both before and after weaving, owing to their differing in powers of resistance to rubbing, it will not essentially affect the strength and elastic behaviour of the sized yarn when applied in the usual way as a paste in water on a normal dressing machine, as practically the same result is given by treating with cold water only.

It is also shown that the major cause of this reduced elasticity of sized flax yarns is the tension applied to the yarn on the dressing machine after being wetted by the water in the size mixture, since the effect is not produced by tension in the absence of water, or by water in the absence of tension. A decrease in elasticity, due to real adhesive action of starch, is shown, but this is relatively small compared with the above.

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Discussion

The Chairman, Mr. Peacy Bean, congratulated Mr. Smith on the patience he had shown and the work he had put into this paper. He said he was sure those present would regret that Mr. Smith had been unable to attend to read the paper himself and that everyone would be grateful to Mr. Farrow, of the British Cotton Industry Research Association, for reading the paper and for preparing the exhibit of solutions in demonstration of Mr. Smith's work. The use of glycerin in sizing had been known for many years, and thirty years ago he had used it, himself, fairly extensively in pure size mixings. Apart from pure sizing, however, there was no useful purpose to be served in employing it as a deliquescent, because the moment one introduced weighting materials in large quantities, such as China clay, Epsom salts, chloride of magnesium, and chloride of zinc, it became too expensive to use in anything like effective quantities. In heavy sizing there was nothing better than chloride of magnesium, which had the double advantage that it was a more powerful absorber of moisture than glycerin, and, at the same time, assisted materially in getting the required weight of size. It might be claimed that glycerin did not crystallise during very dry weather, especially when east winds were prevalent, and that chloride of magnesium did; but these conditions existed only during certain periods in the year. In any case, it was not possible to make size mixings to suit every possible condition, because the operation of sizing was usually conducted some time before the yarn got into the looms, and the yarn then had to remain for periods of from four to twelve weeks before the beams were woven out. In his opinion, apart from pure sized goods, which were intended for bleaching, or for pure sized goods intended for grey shipment, the use of glycerin in the size was an unnecessary expense. There was no material advantage in glycerin for heavy sized yarns which could not be got from chloride of magnesium at much less cost. Continuing, the Chairman pointed out that it had been stated in a text book on sizing that glycerin was more deliquescent than chloride of magnesium. This statement was not true, and it had led to the wasteful use of glycerin in heavy sizing. The author of the statement based his opinion on the result of an experiment in which he exposed glycerin at 52° Tw. and a solution of chloride of magnesium at 60° Tw. in the atmosphere. He found at the end of ten days that the glycerin had absorbed $8\frac{1}{2}\%$ of moisture, whereas the solution of chloride of magnesium had lost weight. Of course it would. The solution of chloride of magnesium already contained 70% of water, and would evaporate until a saturated solution would be formed, whereas glycerin at 52° Tw. was practically free from water. But on the yarn, chloride of magnesium is nearly dry, and in that condition it is capable of absorbing its own weight of moisture in a very short time.

Dr. W. H. Gibson remarked that it was very interesting to hear of such an apparently accurate method of determining glycerin. Could Mr. Farrow say whether it would work quite well with very crude glycerin containing the natural impurities?

Mr. F. D. Farrow said that this method of estimation of glycerol is only worked out in this particular case from the point of view of estimation of quite small quantities in yarns. Neither the qualitative nor the quantitative procedure described in the paper will enable any opinion to be given as to the quality of the glycerol used in size. The colour reactions do, however, permit as small a quantity as one milligramme of glycerol to be detected.

The Chairman remarked that if those engaged regularly in the analysis of cloth, for the purpose of matching size mixings, had to face complete quantitative determinations of glycerin, they would have a very unhappy time and so would the client when he got his bill. Apart from this, the paper was worth a considerable amount of study, but it was a chemist's paper and not for a cotton manufacturer. He then called upon Mr. J. A. Matthew to read his paper (No. 19 above), and asked him before reading the paper to outline the processes employed in sizing linen yarn, as there was a material difference between the processes employed in sizing cotton and linen yarns. Probably all those present knew something about the sizing of cotton yarns, and they might fall into the same error as he did when he read the paper, *i.e.*, reading about linen and thinking in terms of cotton. A brief outline was all that was necessary to enable them to make the necessary comparisons.

Mr. Matthew, before reading his paper, said that he was glad to comply with the Chairman's suggestion, and that in dressing flax yarns, they are first wound on the warper's beams, which are fed up in equal numbers at each end of the dressing machine. The yarns from these beams pass over a guide roller, between the nip of a heavily weighted flannel-covered pressing roller, and the size roller, the surface speed of which is the same as the speed of the yarn. This size roller revolves in the size trough, and so wets the yarn with size. After passing through the rollers, the yarns pass over the surface of a revolving brush, which removes excess of size, through a brass reed, and are then split into two layers by rods to facilitate drying, which is carried out by blowing hot air through the yarns by means of fans. The yarns then pass through a second brass reed, through the bristles of a tallow brush, under a guide roller, which directs them at right angles vertically upwards, through an ordinary "leasing heald" supported horizontally, and so on to the weaver's beam, where an expanding pressing roller rests on the yarns and so ensures a firm beam. The yarns are subjected to considerable tension during the whole time of their passage from the sizing roller to the beam.

The Chairman—The size is not boiling?

Mr. Matthew—No, it is cold. (Mr. Matthew then read an abstract of his paper illustrated by lantern slides.)

The Chairman said that they must congratulate Mr. Matthew on this paper. He had put an immense amount of work into it, and it contained a mass of detail. Whilst not wishing to be hypercritical he must say that the conclusions arrived at were those which applied also to cotton, and which had been known for many years. Much was made of the test for the breaking strength of sized yarns, but however valuable this test might be for unsized yarns, he failed to see what value it was in the case of the former. It was well known that if a yarn could be woven successfully for certain yarns with 10% of size, it did not necessarily improve the weaving qualities if 15% were incorporated; on the other hand, it might depreciate them. But this addition would materially increase the breaking strain. The most important weaving quality of a yarn was its pliability, and no machine had yet been invented which would measure the pliability, or the weaving quality, of a yarn, apart from the loom itself. In this paper nothing had been said about pliability, although, time after time, Mr. Matthew had been on the fringe of it. His experiments with water, his experiments with tallow, and other softening experiments, all seemed to indicate that he was

preparing to deal with this property of the yarn. Pliability was the main feature of a well-sized yarn, and an experienced tape sizer could tell, by feeling the yarn as it wound on the weaver's beam, whether it would be a good weaving yarn or not. It was not necessary for him to take short lengths of yarn and test them on a breaking machine, because his fingers told his brain whether the size was good enough. If during the operation of weaving sized warp, the yarn were subjected to a straight pull, the breaking strength test might be important. But in weaving, the yarn is not subjected to a straight pull, but to a bending action. This action might be compared to the bending of a piece of cardboard and a piece of tissue paper. It would not take many bendings to break the cardboard, but one might go on for ever bending the paper. If, however, the cardboard was subjected to a straight pull in a strength testing machine, it would beat the tissue paper out of the field. The pliability of a sized yarn is dependent upon the amount of moisture contained therein, and the amount of fatty matter. Moisture played a most important part, and he, the Chairman, would have liked the lecturer to say why more humidity was allowed in the weaving sheds in Ireland, where they were weaving linen, than is allowed in Lancashire, where they are weaving cotton. As a matter of fact, cotton is more hygroscopic than linen, and this has been allowed for in the regulations. Not only did moisture render the yarn more pliable, but it added considerably to its strength. On this account no strength tests were of value unless made under identical conditions of moisture and humidity of atmosphere. In these investigations much is made out of the "elasticity" of the yarn. He might be old fashioned, but it appeared to him that "elasticity" was something whereby anything which has been distorted had the power to return to its original shape. He could understand the "elasticity" of glass for instance, but he could not understand the confusion of "elasticity" with "stretch" as applied to yarn. The so-called "elasticity" of cotton or linen yarn depended upon several things, amongst which were the number of turns per inch, the evenness of the spinning, the amount of size, and the amount of moisture in the yarn. There was a good deal more in this matter of pliability than seemed to be thought by the younger investigators at the present time, and, in his opinion, many of the investigations were not being conducted on the right lines. It had probably dawned upon many of them that no machine, apart from the loom itself, was capable of testing the weaving qualities of a sized yarn, and until such time as they obtained a suitable machine they were wasting time in making innumerable strength and elasticity tests on sized yarn. One could get valuable information from such tests before the yarn was sized, but the introduction of size altered the conditions. It was suggested that investigators might be usefully employed in standardising size mixings. This was a hopeless task, and showed that those who suggested research on such lines had no knowledge of the practical side of the subject. There were such a variety of woven goods, made from such a variety of yarns, of such a variety of counts, of such a variety of qualities, that it would not be possible to standardise anything. Many weaving sheds were engaged, in normal times, on many varieties of goods, and the size had to be adapted for the particular goods. Then, again, a size mixing which would be successful in one mill might be altogether unsuitable in another because of the difference in conditions, differences too many to describe here. In the Burnley district there were a good many weaving sheds engaged on similar goods, known as Burnley printers.

In such a district one would think that a standard size mixing could be used, but experience had shown that it could not. After all, experience did count for something, even in these days of graphs and diagrams. There was one test, which might be described as the acid test, which should be applied to all these investigations and papers on sizing. How much are they going to increase production, and at the same time the weavers' wages ?

Many years ago he carried out experiments in sizing in conjunction with a friend who had the control of three weaving sheds, all situated in one mill yard. The same class of goods was woven in all three sheds. The size mixings were altered on definite lines after due consideration, and the results were watched. If the weavers' wages went down as a result of the change, it was concluded that the investigators were on wrong lines, but if they went up, then it was clear that they had made an improvement. Similar experiments were carried out with the object of ascertaining the antiseptic value of chloride of zinc, and the danger line was sometimes closely approached, but fortunately without the owners' knowledge. Some real practical information was secured. It has been said that the world was not given the benefit of these experiments, but this was not so. The facts were stated, but modern investigators demand graphs and diagrams. He was sure that Mr. Matthew would take his criticism in the best spirit; it was what is known as a Lancashire welcome. He uttered his criticism as a warning, because he knew that a tremendous amount of time had been spent, and was being spent, in regard to sizing which was wasted time, and which could be spent to much better advantage. Actually they had not a single new fact brought before them on the subject, in spite of the investigations going on all over the country.

Mr. F. D. Farrow said that Mr. Matthew had assumed that elasticity, *i.e.*, elongation, was an important factor in weaving. He did not know whether Mr. Matthew was right in that assumption or not, and he did not know on what grounds it was made; so far as he knew there was no evidence at all to show whether high breaking load was preferable to high elasticity. This paper was a very valuable examination of some of the physical properties of a warp yarn, but he thought it might have dealt with rather more radical variations of the sizing constituents. If Mr. Matthew pursued his experiments a little further he would probably find that important differences in the mechanical properties of the yarns were produced by varying methods of sizing. The word "pliability" had been used in the cotton trade for many years, without any very exact understanding of its meaning. He fancied Mr. Matthew's "elasticity" measured pliability as accurately as one could do it at the moment. He would respectfully suggest to the Council of the Institute that proofs of the papers be distributed before the meetings. Mr. Matthew had been at great pains to go into a lot of details which could have been omitted if copies of the paper had been supplied.

Dr. S. A. Shorter said that the autographic machine used by the lecturer was not a suitable one for investigating the elastic properties of yarns. It could not be used for recording the effect of very rapid extension and contraction. The actual records shown on the screen gave distinct evidence of errors due to friction and inertia. The question of recording rapid changes had been dealt with recently in the *Journal* of the Textile Institute, and a machine devised which is free from the defects of previous autographic recorders. The lecturer had shown very conclusively that the differences between elastic properties of the different samples had no relation to sizing,

but were due to the combined effects of tension and water. Did treatment with water alone improve the weaving properties?

The Chairman—No.

In that case, continued Dr. Shorter, all that the results showed was that the particular properties investigated were not involved in good or bad weaving, and had no very important bearing on the sizing problem. This effect of tension and water was fairly well known in colloid physics, and was common to all fibres. It was connected with the swelling process and was produced by other liquids which cause swelling. Alcohol is such a liquid and it was noteworthy that the effects obtained by the lecturer with water were also obtained with alcohol.

Mr. F. T. Peirce said the problems that arose in the linen and cotton industries were closely analogous in relation to weaving difficulties, the effects of tension, and of different sizes. There was, however, a fundamental difference, one of kind rather than degree, between flax and cotton yarns. One could easily see that the size penetrated more into cotton yarn and had a greater effect on its properties. Many of the statements made in the paper about flax were known experimentally not to be true of cotton. The cementing action played a bigger part and specific differences between sizes were much more marked, especially in their effect on extension. They had been given the results of an attempt to measure elasticity; this was a very important property but care was necessary in defining it. The figures given would be found to vary considerably with the rate of loading and the time allowed for recovery. In connection with the question of the effect of wetting alone, a big difference was shown in Table II. between the dry yarn and that soaked in water only. This could hardly be real; it must be due to the moisture conditions. Yarn that had been wetted retained more moisture than a dry yarn when the two are conditioned together.

Mr. H. J. S. Dewes suggested that a comparison could be made with a leather belt. If the individual fibres of a leather belt were lubricated with a suitable oil, the belt was made pliable and found to give much better service than one which was allowed to get hard and dry and not kept in a pliable state. He wondered whether a similar effect was not attained by the use of suitable softeners in the sizing process in ordinary mill practice in the weaving sheds of Lancashire to-day. After Mr. Bean's remarks about pliability of the cotton fibre he felt that this simile might be of interest.

The Chairman said that the main trouble with manufacturers and sizers was not that they had not got suitable sizing materials and did not know how to mix and use them, but to the fact that they did not know enough about the after processes to which the cloth was going to be subjected after it left their possession. A size mixing which would be quite suitable for goods intended for one purpose would be quite unsuitable for another. Without going into details, he would say that the most useful purpose served by an experienced chemist, as far as sizing was concerned, was in keeping manufacturers out of trouble, or helping them to minimise the trouble after they got into it. Manufacturers were like ordinary people—they consulted the lawyer when they had blundered instead of consulting him before they made the false step. But this sort of knowledge is open to anyone who reads the published works on the subject and has a knowledge of all sides of the trades connected with the production of cotton goods, from sizing to finishing. He mentioned the Burnley district in the early part of the discussion, saying that one might expect standard mixings in

their class of work. As a matter of fact the sizing of this class of goods was of the simplest, and few mixings could be improved upon if the best ingredients were employed. But here again they differ in different mills, due to differing conditions. In other districts, especially where heavy sizing is carried out or where coloured bordered goods are woven, standard mixings are impossible. He would suggest that there was room for research on the various starches. Everyone in the trade knows that for certain counts of yarn, and certain reeds and picks, the best starch to employ for the size is sago. Why is it that farina and tapioca lose strength when reboiled ? Why should maize starch have different characteristics altogether from wheaten starch ? They are all starches, and one would think that after they have been gelatinised by boiling, they would possess the same characteristics. Then, again, we had not got to the end of the possibilities in mercerising, and there was plenty of room for investigation in regard to cellulose and artificial silk. But in matters of sizing, bleaching, and finishing, there was little or no room for scientific research.

Mr. J. A. Matthew's reply (communicated)—As regards the point raised by the Chairman that differences of atmospheric moisture would affect the results obtained, as is fully described in the text, such a possibility was avoided as far as possible.

In reply to Mr. Farrow, it is agreed that the nature of the starch is of importance in regard to the resistance to rubbing, and it is only in regard to elasticity that the starches (when applied under identical conditions) appear to give the same result, and this was clearly indicated in the text of the paper.

I do not agree with Dr. Shorter that the type of machine employed would have any effect on the conclusions reached. A rapid rate of loading is not essential, and reliable inferences may be made so long as all the test conditions are kept the same for all the samples. This is also borne out from the similarity in the conclusions from these results and from Owen's, who used rapid oscillations of tensions.

The criticism of the next speaker, in regard to the ratio of total/permanent stretch, arose, I think, chiefly through my not having had time to deal fully with the details of the experimental conditions. With flax, further recovery on leaving the yarn unloaded would be small and very slow, but in order to eliminate any such effect from the measurements, reloading was always commenced with as little delay as possible. With more elastic yarns, such as cotton and wool, no doubt the "creeping" effect under stationary load would be proportionately more important, but with the results described, dealing with flax only, there is little reason to suppose that they are vitiated from this cause.

Communicated reply by Mr. G. Smith—

In reply to the Chairman, I may say that, at this juncture, I am not prepared to enter into a discussion *re* the relative merits of glycerol and magnesium chloride as deliquescents. Such a discussion would be entirely irrelevant to the subject of my paper. The fact remains, however, that glycerin *is* being used in sizing and, in my opinion, it is up to the analyst to be prepared to detect the presence of this substance in sized goods, and, if necessary, to estimate the amount.

A point not mentioned in the discussion is that the primary function of glycerin is to replace, not magnesium chloride, but fat. The result of a fat estimation therefore, provided the extraction is performed with petroleum ether or carbon tetrachloride and not with ordinary ether, is of the greatest value, to an analyst with a knowledge of sizing, in determining whether it in necessary to carry out specific tests for glycerol.

With reference to Dr. Gibson's question, several of the sized samples which I used in testing the methods contained crude glycerin, *i.e.*, 80% soap-makers' crude. I have detected no difference in behaviour between these samples and other samples sized with mixtures containing 98% distilled glycerin.

I would like to express here my thanks to Mr. Farrow for his presentation of my paper, and particularly for the experimental demonstration, which he himself suggested, of some of the reactions. G. SMITH.

20—A SIMPLE AND RELIABLE TEST FOR MERCERISATION

By R. W. Kinkead

(The Linen Industry Research Association)

The problem of distinguishing between mercerised and unmercerised material is frequently presented to the textile chemist. Methods at present available include microscopical examination and the use of Huebner's zinc chloride-iodine and aluminium chloride-iodine solutions,* which give a deep chocolate colour on mercerised material, unmercerised material remaining almost unchanged. E. Knecht† and A. B. Knaggs‡ suggest tinting cotton samples with Benzopurpurine 4B, when, on adding a little hydrochloric acid, the unmercerised sample turns blue while the mercerised sample becomes reddish-violet, provided too much acid has not been added. Similar differences are observed with linen materials provided mercerisation has been carried out very fully. The test, however, does not command confidence in general, because different materials require different quantities of acid to render the distinction evident. It appears impossible to find an acid solution of such a strength that it could be used as a general reagent. For instance, an acid solution which gives the reaction with a heavy closely woven damask in a satisfactory manner, is much too strong when testing an open woven cloth or a small cutting of yarn. Such a solution, with these materials, would turn both the mercerised and unmercerised samples a blue colour, while if the acid solution is sufficiently strong to turn the colour of the open-weave unmercerised cloth blue, and leave the mercerised cloth red, then both samples of the heavy damask remain entirely unchanged when treated with this solution. Moreover, the depth of shade produced on the material by the benzopurpurine is also a controlling factor, the deeper the colour the stronger is the acid solution required. This method therefore cannot be considered satisfactory, as in the absence of a similar piece of material known to be unmercerised, it does not give a definite indication. Microscopical examination is not a certain method of distinguishing mercerised from unmercerised material, and with the introduction of new finishing treatments is becoming more and more unreliable. Huebner's iodine methods have been found quite satisfactory with flax yarns. Difficulty is experienced, however, in applying the test to linen cloths. These will, in general, have been starched and finished, and the necessity for completely removing all traces of starch before the iodine test can be applied is a disadvantage where a rapid routine test is required. A very slight trace of starch will give with iodine the deep blue colour of iodo-starch which will mask entirely any colour difference between mercerised and unmercerised material.

The method now to be described resulted from a search for a reagent which would give an indication of mercerisation without necessitating comparison with a sample of similar material known to be unmercerised. The simplicity and, after a little experience, the certainty of the present test will commend it to those who have frequently to decide from the examination

*J.S.C.I., 1908, **27**, 105.
†J. Soc. Dyers and Col., 1908, **24**, 67.
‡J. Soc. Dyers and Col., 1908, **24**, 112.

of a small sample the treatment to which the material has been subjected.

The results described were obtained with a variety of linen cloths, damasks and yarns. Experiments have also been made with cotton, ramie, and hemp materials.

Method of Testing

A small cutting of the material is stained with Methylene Blue by soaking it for a few minutes in a cold approximately 0·001% solution of the dye, containing 0·5% of carbonate of soda. The stained material is rinsed with distilled water and covered in a test tube with about 10 cc. of a 3% sodium carbonate solution (approximately 6·5° Tw.). Four drops of iodine solution are then added. The iodine solution is made up by dissolving 1 gram iodine in 100 cc. of 20% potassium iodide solution. The test solution is heated rapidly to the boiling point, poured off, and immediately replaced by fresh cold carbonate solution. Under this treatment the coloration of mercerised material becomes reddish-purple, that of unmercerised material remaining blue, often with a greenish shade. The test has proved quite reliable for deciding whether or not a linen material has been given a normal mercerising process (*i.e.* treated with a caustic soda solution of a density not less than 40° Tw.). If an unmistakable purple colour is not obtained it may be concluded that the material has not been mercerised by a normal process. The effects of certain other treatments (*e.g.* the use of solutions of caustic soda of a density below 40° Tw. and the use of strong solutions of acids, &c.) are described below, but the indications given by the test in these cases are not regarded as perfectly definite.

Precautions

Prolonged heating of the stained material in the carbonate solution should be avoided as a considerable amount of the colour is thereby removed from the sample. In many cases, indeed, it will be seen that the colour change occurs on very slight warming, and when a qualitative test only is required, this is sufficient evidence of mercerisation. The pouring off and replacing of the first lot of carbonate is desirable because a considerable amount of colour is stripped from the material, making a blue solution, which may partially mask any colour change produced. Another advantage of this procedure is that the material is brought to room temperature very rapidly. A hot solution allowed to act for about a minute may bring about a slight colour change towards purple on unmercerised material, but the addition of cold soda restores the original blue colour. Similarly a sample which has been mercerised very slightly may assume quite a reddish-purple colour when hot, but becomes much bluer as the solution cools. The second solution should not be heated as almost any alkaline solution, however weak, will produce the colour change on unmercerised material if allowed to act for sufficient time at a high temperature. The shade of the unmercerised material is quite unaffected by the carbonate solution under the standard conditions of the test, as may be seen on comparison with a blank experiment in which the tinted material has been boiled in distilled water. After remaining in the cold carbonate solution for 3–4 hours, the shade of the unmercerised material will be only slightly changed. The difference between the colours of mercerised and unmercerised material is quite distinct after remaining in the carbonate solution for three days. The function of the iodine is to oxidise any reducing substances present in the

material which would reduce the Methylene Blue to the colourless leuco-compound. In alkaline solution Methylene Blue is easily reduced by the action of various compounds which may be present in the material to be tested. Experiments show, however, that apart from this retardation of the reduction of the dye the presence or absence of the iodine is immaterial.

Discussion of Results

The shade of colour produced on the mercerised material depends upon the degree of mercerisation. A range of samples of 8's lea flax line, bleached three-quarter white, was mercerised under tension with caustic soda solutions of densities rising by 10° Tw. from 20° Tw. to 70° Tw. The results of the test are shown in the following table—

Specific gravity of Caustic Soda Tw.°		Colour change
Nil	...	Bright blue, no change.
20°	...	Only very slightly redder.
30°	...	Definitely redder.
40° and 50°	...	Full purple and definitely the reddest of the series.
60° and 70°	...	Rather bluer than 40° and 50°.

An attempt is made in the accompanying plate to illustrate the different colours obtained in the above series of experiments. The shades will, of course, vary with the depth of shade of the staining by Methylene Blue, and also will not be quite the same with different materials. A yarn, for instance, may appear brighter in colour than a cloth. The relative results will, however, be the same.

While differences in the colours of the different mercerised samples shown in the table could not be considered as a very accurate criterion of the strength of the caustic soda employed in the mercerisation, it is quite possible, after some experience and by comparison with a range of known samples, to gain some information on this point.

This test has been employed on a number of different linen cloths, some of which had been mercerised under industrial conditions. Other cloths were mercerised under known conditions in the laboratory. Practically no difference has been found in the behaviour of cloth mercerised under tension with that mercerised without employing tension when mercerisation was carried out fully in each case. The test may be slightly affected by the presence of finish on the cloth, especially when mercerisation has not been carried out very fully. A very lightly mercerised material may not show any colour change at all under the standard conditions of the test if it contains considerable quantities of finishing materials. The finish apparently retards the reaction to some extent. It is advisable, in doubtful cases, to destarch the material, but the removal of the finish need not be so complete as is required by the iodine test, and in most cases is quite unnecessary. If very large quantities of starch are present, however, difficulty may be experienced on account of the reduction of the Methylene Blue. In practically any case, boiling for 10 minutes with 3% sodium carbonate solution will remove the starch to a sufficient extent.

Application of the Test to Various Materials

Tendering by boiling for one hour in sulphuric acid of concentration of 1·6 grams per litre does not invalidate the test. Pieces of linen cloth, mercerised and unmercerised, which were tendered in this way, gave the reaction exactly as the original untendered material. Mercerised and

unmercerised linen cloth which was completely rotted by soaking in deci-normal sulphuric acid and heating for one hour in an oven at 98° C., showed the colour difference almost as well as the untendered samples. A linen damask was mercerised in the brown state and, together with a similar piece of unmercerised material, was taken through the ordinary bleaching process. The test was not affected by this procedure, the reaction of the mercerised cloth being exactly the same as with similar cloth mercerised subsequent to bleaching. A small piece of the damask which had been bleached after mercerisation was tendered by prolonged treatment with chemic* of density 1° Tw., followed by the usual washing and souring treatments. Under test the cloth was shown to be free from acid and active chlorine. The sample failed to give any reaction for mercerisation by the method described. This was the only treatment either before or after mercerisation which has so far been found to invalidate the test.

With lightly mercerised fabrics in which some threads are "floated" over several others (*e.g.* for the production of a pattern), the ground-weave being of a different, closer structure, unmistakable evidence of mercerisation may be given only by the floats.

This peculiarity of materials containing floated threads has been seen also when using Huebner's iodine test for mercerisation. When the soda solution has been allowed to act to its greatest possible extent there is, of course, no difficulty in applying the reaction, because, under these conditions, the ground as well as the floats shows the purple colour due to mercerisation.

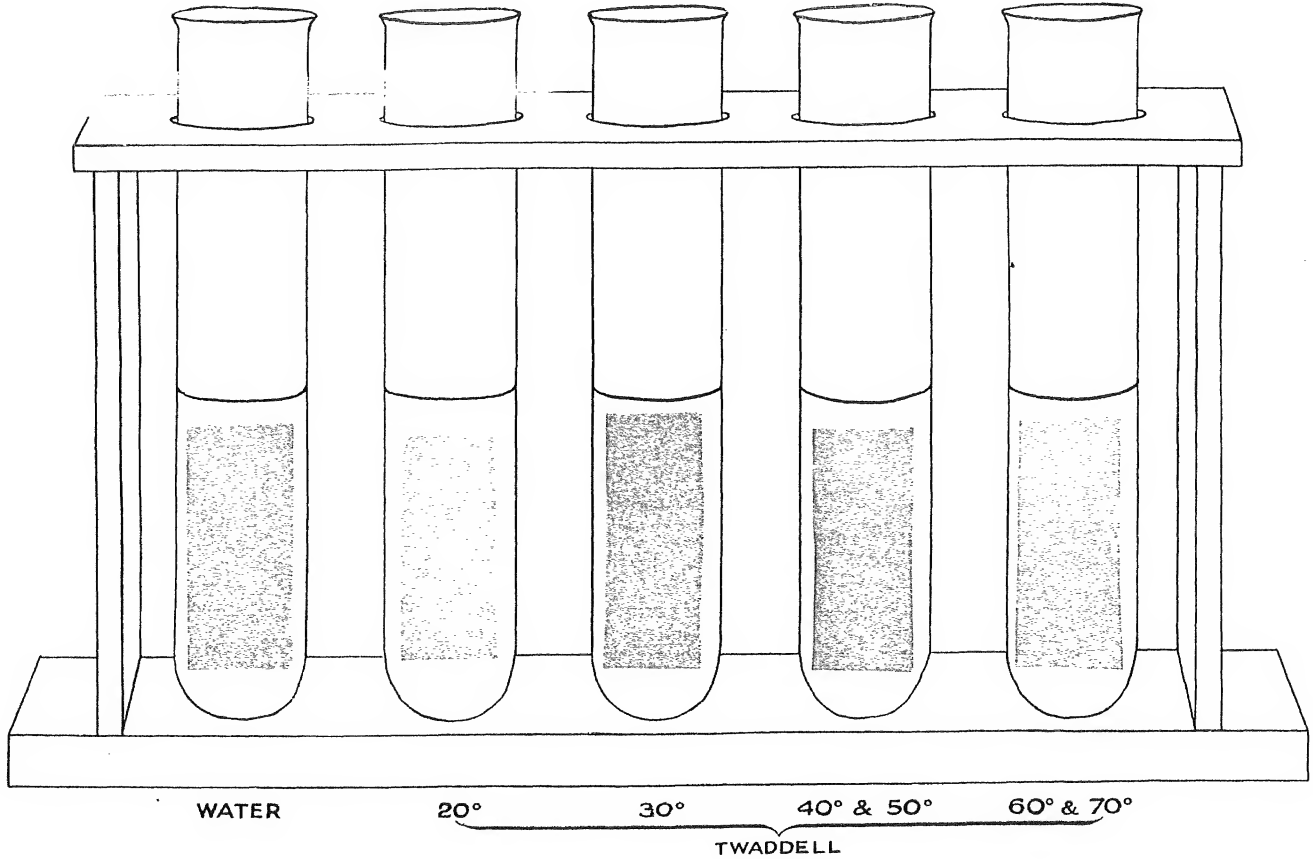
The mercerisation of flax twines, both boiled and fully bleached, has been investigated by this method and the test was found to be quite reliable in distinguishing the mercerised from the unmercerised twine.

A number of dyed linen cloths, mercerised and unmercerised, were tested; the dyes employed including both the vat and the direct type. All the mercerised samples gave a good positive reaction. In the case of the direct dyes the colour was first stripped with hydrosulphite or titanous chloride. Where the colour of the material was of a light shade it was sometimes found that the test could be conducted successfully without stripping the dye. To ascertain whether the stripping reagents had any effect on the test, undyed mercerised and undyed unmercerised cloth was boiled for five minutes with a 10% solution of hydrosulphite and a 2% solution of titanous chloride. In neither case did this treatment affect the test.

Reference to Huebner's paper† will show that the iodine test gives a satisfactory reaction for mercerisation when the material is treated with strong mineral acids, assuming the chocolate colour with a zinc chloride-iodine solution characteristic of mercerised material under this test. During the present investigation samples of flax line yarn were treated under tension with (i.) concentrated nitric acid for 20 seconds, (ii.) concentrated sulphuric acid for 30 seconds, (iii.) concentrated hydrochloric acid for 1 minute. Ramie yarns treated for three minutes with nitric acid of 82° Tw. under tension and when loose were also tested. A calcium thiocyanate solution is sometimes employed to obtain an effect similar to mercerisation. Flax line yarn was therefore prepared for testing by treating it for three minutes with a solution of this salt of sp. gr. 1·4 (boiling point of solution 135° C.) at a

*The term chemic is generally used to denote the calcium hypochlorite (bleaching powder) solution employed in the ordinary bleaching process.

† *Ibid.*


WATER
20°
30°
40° & 50°
60° & 70°
TWADDELL

temperature of 90° C., after which it was washed, soured, washed, and dried. The following table shows the results obtained in this series of experiments.

	Mercerisation Agent	Colour change
Flax	1—Nitric acid (83° Tw.)	... A slight change towards purple, very similar to that obtained with yarn mercerised with caustic soda of density 30° Tw.
	2—Sulphuric acid ... (169° Tw.)	... Colour change same as with nitric acid (1).
	3—Hydrochloric acid (33° Tw.)	... Colour change not quite so marked as with 1 and 2. May be compared with yarn mercerised with caustic soda of density 20° Tw.
	4—Calcium thiocyanate (80° Tw.)	... Result very similar to that obtained with nitric acid (1). Colour is slightly redder.
Ramie	5—Nitric acid (82° Tw.) Mercerised loose	... Slight colour change. Very similar to the result on flax shown above (1).
	6—Nitric acid (82° Tw.) Mercerised under tension	... Same as previous experiment (5).

Flax yarns which had been mercerised under tension with caustic soda solutions of density 50° Tw. and 60° Tw. were remercerised by treating under tension with concentrated nitric acid 83° Tw. for three minutes, washed, and dried. The colour change produced was the same as that obtained with the yarn which had been treated with caustic soda alone. It will be seen that the iodine test and the present reaction give, in conjunction, a method of distinguishing material which has been mercerised with acid from that which has been mercerised with caustic soda. If the iodine test gives a positive reaction while the Methylene Blue-carbonate method gives a negative or very slight positive result, one may be fairly certain that the material has been treated with a solution of a substance other than caustic soda.

Cotton cloths mercerised and unmercerised behave, under this test, in the same way as linen cloths. When testing cottons it was found that the 3% solution of carbonate produced a slight change towards violet in the unmercerised material. A similar slight change is produced on unmercerised linens by a 7% solution of carbonate or a $N/50$ solution of sodium hydroxide. The carbonate solution for cottons should not be stronger than 1%, which acts on cottons much in the same way as does a 3% solution on linens.

Further experiments have been made employing mercerised and unmercerised flax, ramie and hemp yarns, bleached and unbleached. The mercerisation was carried out by treating the yarns under tension with caustic soda of density 40° Tw. for three minutes. A 3% carbonate solution was used as the reagent throughout the series of tests. The results obtained are shown in the following table—

Yarn	Colour change
Bleached flax mercerised ...	... Full red purple.
,, unmercerised	... Unchanged.
Bleached ramie mercerised	... Red purple.
,, unmercerised	... A slight change towards violet is produced.
Unbleached ramie mercerised	... Red purple.
,, unmercerised	... A slight change as with the bleached yarn.
Bleached hemp mercerised	... Red purple.
,, unmercerised	... A rather greater change than with the corresponding ramie yarn.
Green hemp mercerised ...	... Purple colour fairly good, but it is masked a great deal by the colour of the yarn.
,, unmercerised ...	... Same as with bleached yarn. The colour of the yarn is again a difficulty.

It will be seen from this table that the 3% carbonate solution is not satisfactory for testing ramie or hemp. Quite a considerable colour change occurs with unmercerised bleached hemp. The difference between mercerised and unmercerised ramie and hemp materials is readily seen, however, if a 1% carbonate solution is used. The reaction might therefore be employed as a qualitative test for hemp in flax materials. Thus, if a change occurs in a reputed flax material, which is known to be unmercerised, when employing a 3% carbonate solution, it may be suspected that it contains a certain admixture of hemp fibre. There are, however, other more trustworthy tests for hemp. This difference in the behaviour of flax and hemp may be of considerable importance when employing the test. A reputed pure flax unmercerised material after preparing with the Methylene Blue solution and tested with a 3% carbonate solution may react as though slightly mercerised when the colour change is really due to adulteration of the flax with hemp fibre. A test for hemp* should be made if there is any doubt as to the purity of the flax material.

The possibility of using alkalis other than sodium carbonate has been investigated. Sodium hydroxide in concentration of $N/50$ is fairly satisfactory but produces a slight change towards violet with the unmercerised material. Sodium hydroxide solutions weaker than $N/50$ will produce the purple colour characteristic of mercerised material but have the disadvantage that they require to be heated a considerable time, and the Methylene Blue colour may be entirely stripped before the reaction takes place. $N/25$ sodium hydroxide produces quite a strong purple on unmercerised material on warming very slightly and will also change the colour a little in the cold. $N/10$ sodium hydroxide changes the colour of both the mercerised and unmercerised material to purple very rapidly in the cold.

Potassium and lithium hydroxides react similarly to sodium hydroxide of the same normality. Potassium carbonate gives results exactly similar to those obtained with sodium carbonate. Ammonium hydroxide and ammonium carbonate give no appreciable colour change even in high concentration. Saturated lime water gives the reaction quite well, but also attacks the unmercerised material to a slight extent, rather more than does $N/50$ sodium hydroxide.

None of these alkalis has any advantage over sodium carbonate. The hydroxides all change the blue colour of the unmercerised material towards violet to a slight extent. This is of little importance if one is merely comparing two samples, but is a great disadvantage when testing an unknown material. The value of the carbonate, either sodium or potassium, of the correct strength for the material under investigation, is that it leaves the colour of the unmercerised sample unchanged, so that if a blank experiment is carried out side by side with the sample to be tested by boiling a piece of the tinted material with distilled water, absolute certainty can be attained.

Methylene Blue was the dye mainly employed in these experiments. A similar result was obtained with Methylene Violet. The Methylene Blue was the pure hydrochloride, free from zinc. The commercial zinc chloride compound with Methylene Blue may, however, also be used if reasonably pure. A number of other basic dyes were examined but no corresponding result was obtained.

*C. R. Nodder, J. Text. Inst., 1922, **13**, 161; Linen Research Inst. Memoir No. 7 gives a rapid and convenient test for hemp and flax, depending on the twisting behaviour of these fibres on drying, flax twisting clockwise and hemp anti-clockwise when the free end cf the fibre is directed towards the observer.

SUMMARY

A new test for mercerisation is described. A small sample of the material is stained with Methylene Blue and heated with a dilute solution of sodium carbonate under standard conditions. Under this treatment the mercerised material turns reddish-purple, the unmercerised remaining blue. It is possible by comparison with a range of known samples to estimate the approximate concentration of the caustic soda employed in the mercerisation.

Materials mercerised with strong mineral acids behave differently under this test from those mercerised with caustic soda, a result which in conjunction with the positive reaction obtained with the iodine test makes it possible to distinguish these materials.

21—RANCIDITY AND OXIDATION OF FATTY OILS IN REGARD TO WOOL LUBRICATION*

By W. Rhys-Davies

INTRODUCTION

The subject of wool lubrication covers an extensive field throughout the textile industries and has not received detailed theoretical study. It is of the greatest importance, not only in itself, but in the subsequent operations of cloth finishing. Spinning oils vary from the high-priced olive oils for the fine worsted yarns to the so-called "black and brown oils" obtained from recovery plants. For the purposes of this dissertation it is my object to concentrate and deal with the problems connected with one branch of the wool textile industry, namely, the worsted trade, and to put forward observations extending over many years.

The requirements of a spinning oil are primarily those of a lubricant—oiliness—low viscosity to prevent choking of the card clothing and combs, non-corrosive properties (low acidity), high flash point, and absence of any staining effects. The textile value of oils, as far as the worsted industry is concerned, is largely regarded from the standpoint of the amount of free fatty acids, expressed as "oleic acid." It is just as essential to remove the oils from the finished cloth, preparatory to dyeing, as it is to utilise them in the earlier stages of carding, combing, and spinning. These requirements were considered in the trade to have been met by the use of commercial grades of olive oils, because, in their original state, they are clean in working, non-staining, fairly neutral, and easily emulsified with soda and soap in the scouring process. Olive oil is classified as a non-drying oil, and as a wool lubricant was considered to be immune to changes when in contact with wool fibre in the form of tops and yarns. It will be shown how much change takes place in vegetable oils during contact with fibres.

Whilst it is essential for the paint and varnish industry to use oils whose drying properties are paramount, the textile industry, on the other hand, generally requires those oils as lubricants which do not dry and produce hardened films on the fibre, since such films cause great difficulty in the subsequent operations of scouring, dyeing, and finishing. The whole problem concerning these changes is one of practical importance, and a solution of commercial value is very desirable since expensive oils, such as olive, should not degenerate in textile practice, but retain the properties of original oiliness and viscosity for a period of several months.

PHYSICAL AND CHEMICAL CHARACTERISTICS

The general characteristics of the oil extracted from wool tops and worsted yarns are—

(1) A darkening of the oil.

(2) Distinct differences in odour and taste (rancid).

* This paper was read by Mr. George F. Pickering at a meeting of the Yorkshire Section of the Institute on 15th April. The discussion thereon follows on pages T230—T232

(3) The oil is much more viscous.

(4) Increase of refractometer figures.

(5) An ever diminishing iodine value.

(6) Increase in the "titre" of the insoluble fatty acids.

(7) Notable rise in specific gravity.

(8) The oxidised oil acids become chromogenetic and stain wool, either as sliver or yarn, a brownish-yellow colour, not removable in scouring by any known chemical agent.

(9) The oxidised portion of the mixed fatty acids has a characteristic insolubility in petroleum ether but ready solubility in strong alcohol, hence they can be determined quantitatively.

(10) There is notable increase in mean molecular weight.

CHANGES AND MODIFICATIONS ON FIBRES

It is found that all vegetable oils, including the so-called non-drying group, become considerably changed after prolonged contact with textile materials, as the amount of oil used is relatively small and the surface, to which the oil is exposed, enormously great. For example, a fine botany wool top, oiled with 3% of olive oil, gradually assumes a different character. The oil becomes more acid and, with increasing hydrolysis and consequent production of free fatty acids, rancidity develops with concurrent oxidation of the free fatty acids and normal glyceride oil. The oxidised oil acids so formed are dark brown, varnish-like, and sticky to the touch. It is well to remember that some forms of oxidised acids are stickier than others, and that some may become quite firm, which properties may be due to differing degrees of oxidation or to the respective amounts of the two unsaturated liquid acids which have become oxidised. Before this can be definitely proved, much more work is required to be carried out.

Acidity as Free Oleic Acid

The commercial brands of olive oils used in the worsted industry, for the most part, do not contain more than 5% of free fatty acids. From observation by the writer, the amount of free acidity originally present in the oil does not appear to influence the objectionable changes which proceed on oiled tops and yarns. Within a few months the oil becomes so rancid and thickened as to give acidity figures of 15% and more. It is not to be inferred, however, that the high acidity figures produced are a measure of the amount of "rancidity," since rancidity has no numerical value. Most probably rancidity may be regarded as a state or condition of the oil which develops concurrently with oxidation. From long experience in the wool textile industry, it is realised that acidity is always accompanied by degradation of the original oil into oxidised products to the extent of approximately 5% to 18% of the weight of oil extracted from the wool top, but these products may also occur to a greater extent than the acidity formed would indicate, showing oxidation of the neutral glycerides present to have occurred.

But even these percentages are often exceeded, depending upon the quality of the oil, that is, the nature and composition of the mixed fatty acids, since olive oil is composed of the glycerides of the solid acid, palmitic acid, and the two liquid acids, oleic and linolic acids.

Products of Oxidation

Oxidised oil acids appear to be the final products of oxidation consequent upon the production of rancid mixed fatty acids containing ethylenic linkages, and their formation is common both to vegetable and animal oils under the same conditions. Further, it has always been recognised in the trade that oiled tops and yarns eventually become "tacky" to the touch and, at a later stage, even sticky. Since this always occurs after the use of adulterated oils, the erroneous explanation has been that the olive oils used must have been adulterated or admixed with inferior oils of the semi-drying or drying classes. Moreover, olive oils are regarded as inert by the larger section of the trade, and therefore immune to changes due to air oxidation when used for wool lubrication.

TECHNICAL DEFECTS CAUSED BY THE OXIDATION OF WOOL OILS

In the worsted industry there has been, and still continues to be, great financial loss, especially in dyed goods, caused by the presence of oxidised oil on the fibres. These defects are often only revealed in dyed pieces when an abnormal degree of variation of shade is observed. The special faults in question are most noticeable on piece-dyed worsteds in various weaves. The fabrics often show streaks and bars, which sometimes run with the warp and sometimes with the weft, and if yarns have been used after long storage for both warp and weft, very irregular uneven dyeing takes place. There are many instances where the presence of oxidised oil has been observed when the pieces have been perched in the grey, prior to dyeing and finishing. Extraction by means of petroleum ether showed in these areas oily matters of greater viscosity than normal oil; on analysis, oxidised oil acids were found to be present in much greater amount than in the oil extracted from the non-stained portion of the cloth.

Oxidation of Olive Oils

Richardson and Jaffé (*J. Soc. Chem. Ind.*, 1905, **24**, 534) find that some olive oils thicken and become gummy by oxidation much more readily than others, and are therefore less suitable for oiling wool. This property has no necessary relation to the "free fatty acid" content, the source of the oils being of far greater importance. Their method of testing the oxidisability of an oil is to place 10 grams of the sample in a tin tray measuring $4 \times 6{\cdot}5 \times 0{\cdot}5$ inches, and placed in a special oven, and to pass over the oil a current of air heated at 100° C. for six hours, or at 204° C. for four hours. They then determine the time of efflux at 100° C. of 5 cc. (before and after heating) of oil by means of a jacketted 5 cc. pipette. They give the following figures—

Table I.

Description of oil	Free Oleic Acid	Percentage increase of Viscosity after heating: 6 hours at 100°	4 hours at 204°
Gallipoli	21·30%	10·5%*	—
Seville	3·82%	32·6%*	—
Gallipoli	4·23%	—	73%*
Seville	4·23%	—	644%*
Levant	12·69%	—	315%*

*This increase in viscosity is, of course, due to the oxidation which has taken place.

Hyland and Lloyd (*J. Soc. Chem. Ind.*, 1911) state that owing to the production of partially hydrogenated oils having chemical and physical

values similar to those of olive oil, such are being placed on the market as substitutes for olive oils for use in the worsted trade. They go on to state that these substitutes have an iodine value almost equal to that of genuine olive oil, but, unlike olive, gradually become "tacky" when exposed in thin films to moist air, as, for instance, on oiled tops. . . . Accepting these findings to be true in regard to "substitute oils," not necessarily hydrogenated products, they have overlooked the fact that genuine olive oils are subject to the same fault which is common to all fatty oils—vegetable and animal—possessing unsaturated fatty acids. It is only a matter of degree.

EXPERIMENTAL

Before dealing with the analysis and examination of the oils extracted from wool tops and yarns, it would be well to give typical results of analyses of commercial oils used as wool lubricants to be followed by analytical data obtained on some oils after removal by petroleum ether from "tops."

Table II.

Analyses of Olive Oils.

References	*D–42*	*D–43*	*F–118*
Specific gravity at 60° F.	0·9130	0·9187	0·9176
Unsaponifiable matters	1·24	1·15	0·91%
Acidity as free oleic acid	2·47	5·25	7·80%
Refractometer number, Z.B. 40° C.	54·95	54·80	55·25
Iodine absorption value	83·13	82·49	83·82%
Hehner value	95·44	95·55	95·25%
Halphen colour test for the presence of cottonseed oil	negative	negative	negative
Constants of Mixed Fatty Acids—			
Mean molecular weight	281	287	287
Neutralisation number	199	195	195
Melting point	25°	28°	25/26° C.

Referring to the analyses of typical olive oils, the data shown in Table II. adequately conform to the requirements for genuine commercial oils. The iodine absorption values are quite normal and adulteration with other possible oils was found not to have been done. The practical utility, however, of these oils is different.

Some oils will degenerate and oxidise more rapidly than others on the wool fibre, although their iodine numbers are very similar and their free acidity figures not far removed.

Again, one oil having an initial acidity of 2·82% and no apparent traces of oxidised products, will after contact with clean scoured wool (3% of oil on the weight of wool) give figures as follows—

	1st Month	2nd Month	3rd Month
Acidity as free oleic acid	5·70	10·97	12·11%
Oxidised oil acids	12·75	14·21	19·63%

Table III.

Examination of Wool Tops for Oil Quality.

	232	246	260	279
Total oil (ether extraction)	3·30	3·20	3·40	3·15%
Analysis of the extracted oil—				
Unsaponifiable matters	12·28	6·01	11·11	11·73%
Acidity as free oleic acid	14·77	6·22	10·02	15·25%
Mixed fatty acids } Total	83·61	71·96	82·88	84·53%
Oxidised oil acids } acids	1·32	14·61	3·33	1·02%
		First decimal.		
Constants of the Mixed Fatty Acids—				
Mean molecular weight	292	308	292	307
Neutralisation number	191	181	191	181
Melting point	18–19°	21–22°	18–19°	17–18° C.
Iodine absorption value	79·92	69·14	72·82	81·38
		First unit.		

Comparing the analyses of the "top oils" in Table III. with those of olive oils in Table II., it is shown that characteristic changes have taken place. All four extracted oils were found to be rancid, using the Kreiss test. There appears to be no doubt that polymerisation of the normal oil takes place whilst atmospheric oxidation proceeds.

Amongst the decomposition products found are aldehydes, lactones, hydroxy-acids, peroxides, and volatile acids, which are identified by the ordinary methods of analysis. During the examination of oils extracted from textile materials for nature and quality, the decomposition products mentioned, other than the oxidised oil acids, are lost in the processes of cleaning up, and preparation for, the quantitative separation of the oxidised oil acids. In the matter of peroxide formation, it is desirable to mention here that "peroxides" are found in commercial olive oils where high acidity oils have been lowered by treatment with alkali to meet the requirements of the trade for free fatty acid content of under 5%. The influence of these peroxides on the rate of oxidation of an oil will be mentioned in the discussion on the Mackey Cloth Oil Tester.

The results of analysis of the oil as extracted from oiled wool material require interpretation. The outstanding characteristics are the high unsaponifiable oil figures, increased free fatty acids, and reduction in amount of the insoluble fatty acids, together with lowered iodine values and increased mean molecular weights.

i.—The unsaponifiable portion is always a variable and depends upon how thoroughly the wool has been scoured, for in no instance is all the grease removed in scouring, as it is necessary to retain softness in handle. Therefore these figures represent the sum of the unsaponifiable part of the olive oil (0·6% to 1·8% approx.) and the unsaponifiable matters of wool grease (35% to 40%). Often mineral oil is found, especially where such oil enters into the composition of a carding oil.

ii.—Although wool is originally lubricated with olive oils of low acidity, it is suggestive that natural hydrolysis proceeds in the same manner as with oil stored in tanks. (*See* Lewkowitsch, "Oils, Fats, and Waxes," Vol. I., on "Hydrolysis.")

iii.—The total mixed acids in the analyses correspond to the figures representing the original insoluble fatty acids, but they are not constitutionally the same. Those calculated on an oil free from unsaponifiable matter are normal in amount where oxidation is not far advanced, but where oxidation has proceeded further the total acids decrease. There is no

definite information obtained as yet, but repeated examinations show that they contain "hydroxy-acids" which yield to acetylation.

iv.—The mean molecular weight is always found to be higher than that of the fatty acids from normal oils, and apparently increases in proportion to the amount of hydroxy-acids formed and also to the presence of wool grease fatty acids, which have a mean molecular weight approximating to 340.

More investigation is necessary before any definite and reliable information can be obtained which will give satisfactory explanation of the changes experienced by fatty oils.

Separation of the "Oxidised Oil Acids"

A known weight of the filtered, clean, extracted oil is taken, titrated in neutral alcohol for acidity, then saponified with alcoholic potash in the usual manner. The unsaponifiable oil is removed by repeated extraction in separators with petroleum ether. The lower alcoholic solution, together with the washings of the petrol layers, is transferred to a beaker and evaporated until non-alcoholic. The contents of the beaker are dissolved in hot distilled water, transferred to a separator, decomposed with mineral acid, cooled, and the whole shaken with petroleum ether.

The separator and its contents are allowed to stand until the petrol layer has completely separated and the acid layer has become clear, when the lower acid layer is run into another separator and the shaking with petroleum ether repeated. The oxidised oil acids can be caused to adhere to the sides of the separators in the petrol layers. The acid liquor is run away and the petrol extracts washed with warm distilled water until free from mineral acid. The petrol solution is passed through a dry filter paper and the oxidised oil acids thoroughly washed with petroleum ether to remove any adhering petrol-soluble fatty acids. The oxidised oil acids are very soluble in warm alcohol and are readily removed from the sides of the separators and from the filter paper. The alcohol solution containing the oxidised oil acids is transferred to a weighed CO_2 flask, the alcohol evaporated off, and the flask and its contents dried in the water-oven and finally weighed. For obvious reasons, it is preferable to saponify again the weighed-off oxidised oil acids and repeat the separations in order to finally obtain a product giving constant values for "neutralisation number" and "mean molecular weight."

SEPARATION AND DETERMINATION OF THE SOLID AND LIQUID ACIDS (Gusserov-Varrentrapp Method)

This method, known as the lead-salt-ether process of separating the solid from the liquid fatty acids, can be considered at best as only approximately quantitative. No doubt the best results are obtained when the extractions with ether are carried out at very low temperatures, as in an ice chest, and the liquid oil acids dried in a water-oven through which passes a continuous current of dry carbon dioxide gas.

Analysis of the Liquid Acids

Lithium Method after Dr. C. W. Moore—After determining the iodine value of the mixed liquid acids they are dissolved in absolute alcohol, using 20 cc. per 5 grams of the mixed fatty acids taken. To the solution are added 20 to 25 cc. of a saturated solution of lithium hydroxide.* It is better to

*In Alcohol—*Author*

regulate the amount of lithium hydroxide so as to just neutralise the fatty acids to phenolphthalein indicator. When left, preferably overnight, a crystalline precipitate of lithium oleate is obtained which is collected on a filter and washed with 70% alcohol. The oleate formed is then decomposed with hydrochloric acid, the liberated oleic acid taken up with methylated ether, the ether solution transferred to a weighed, wide-mouthed, stoppered CO_2 flask, and the ether distilled off in a current of dry carbon dioxide, and the residue quickly dried and weighed. By this method an oleic acid is obtained yielding an iodine value varying between 89 and 91, and a mean molecular weight of 280 to 283—theory requires an iodine value of 90·04 and a molecular weight of 282. The method is found to be very satisfactory for types of oil containing but two liquid acids.

The filtrate—the alcoholic lithium solution—is evaporated carefully until free from alcohol, transferred to a separator, and decomposed with hydrochloric acid, the liberated fatty acid dissolved in low boiling point petroleum ether, the petrol layer washed free from mineral acid, allowed to stand over granular calcium chloride, and finally run into a stoppered CO_2 flask. The bulk of this petroleum ether is distilled off, leaving only about 20 cc. A slight excess of bromine is added, the flask is attached to a reflux condenser, and the liquid boiled gently for some time, then allowed to cool gradually. Crystals of the tetrabromide of linolic acid separate out, the melting point of which, after recrystallisation from petroleum ether, approximates to 114° C.

This latter separation is merely qualitative as far as this work is concerned; the linolic acid was never directly determined, the amount being calculated from the observed iodine value of the mixed liquid acids. The separations thus effected cannot be considered as absolute, but, as all the operations are carried out under conditions almost identical, the results obtained can be regarded as usefully comparative.

In the case of all olive oils, from whatever source, the liquid fatty acids have had an iodine value beyond 90. When all considerations are taken into account, namely, the lengthy and tedious separations, and, most important, the susceptibility of the unsaturated liquid acids to oxidation, it is found that the practical performance of an oil and its general suitability for oiling wool and yarns can be best determined by an apparatus which gives directly the rate of oxidation within two to five hours, according to the relative proportions of the three constituent glycerides and "free fatty acid content." Most commercial olive oils consist of the glycerides of palmitic, oleic, and linolic acids in varying quantities, and, only in isolated cases, does one meet with an olive oil containing the two solid acids, palmitic and stearic, together.

MACKEY OIL TESTER

This apparatus is a cylindrical copper water-bath of special design. Its construction is suitably described in Lewkowitsch, "Oils, Fats, and Waxes," Vol. III. The instrument was designed for the purpose of testing the lower-grade oils used by woollen manufacturers, for suitability for oiling wool, which oils have to meet certain requirements in regard to fire insurance. The tester has been found, however, to have wider application; it can be used for the practical valuation of the more expensive wool lubricants, namely, olive, arachis, and blended vegetable oils sold as olive oil substitutes, for it indicates their comparative rate of oxidation, and thus reveals the presence of more or less unsaturated fatty acids.

As far as one can judge at present, the degradation products after heating the oils on fibre through the apparatus are the same as those obtained by slow atmospheric oxidation. In any case, the resinous oxidation product is the same as that produced on oiled tops and yarns, and this is really the fraction which is of most concern to the textile industry. For this reason the behaviour of oils in the Mackey Tester has been regarded as directly comparable with that obtaining in textile practice.

Briefly stated, it is found that this apparatus, for all practical purposes, affords reliable indications in physical and chemical directions as to the behaviour of oils in practice when used as wool lubricants, and therefrom enabling judgments to be passed as to the nature of the mixed liquid fatty acids. Whilst the iodine value possesses certain merits as a source of information regarding normal glyceride oils it has to be somewhat discounted as applied to variations of normal oils which, while not sufficient in themselves to show marked differentiation in iodine number between good, medium, and unsuitable oils, are all important from practical considerations. From observations it is inferred that the determination of the iodine absorption number for the valuation of oils has been much overrated, and cannot be considered alone as affording a safe criterion of judgment. Consequently, the utility of the Mackey Tester assumes a position of high importance for trade purposes, providing, as it does, direct information replacing several chemical determinations of hitherto unappreciated value, such as the Maumené, Livache, Bromine Thermal, and modifications of the various "heat-oxidation" tests.

EXPLANATION OF TABLES IV. TO VI.

Tables IV. and V. are intended to show the remarkable variations in the rate of oxidation, which in some cases approximates to spontaneous combustion, on heating in the Mackey Tester. The figures are taken promiscuously from a daily record of olive oils tested for commercial purposes in this manner, and on examination it will be observed that in some cases an oil having comparatively low iodine value and low initial free acidity figures has increased in temperature more rapidly than an oil possessing higher iodine value and acidity. These findings appear to substantiate the general inferences and statements made throughout this work.

Table VI. sets forth experimental results involving chemical separations of the mixed fatty acids and the determination of the iodine numbers of the mixed liquid acids, with the amount of linolic acid calculated therefrom. The rate of oxidation in these cases bears a closer relation to the iodine value of the mixed liquid acids, which supports the usefulness of the Mackey Tester.

Table IV.

Reference	*D239*	*E1080*	*E1072*	*F173*	*F199*	*C538*	*E392*	*E635*
Nature of oil ...	Olive	Olive	Olive	Olive	Olive	Olive	Olive	Olive
Free fatty acids ...	6·84	7·01	2·59	1·88	1·55	1·92	2·71	5·58
Iodine value	83·49	80·70	80·67	80·52	84·40	84·76	82·30	84·11
Temp. in 60 min. ...	95·0	97·0	100·1	97·0	96·5	94·0	96·9	92·0
,, 75 ,, ...	97·0	98·0	102·9	98·0	96·9	95·5	98·3	93·0
,, 90 ,, ...	98·1	99·0	108·2	98·0	97·2	96·5	100·5	93·5
,, 105 ,, ...	99·2	100·0	115·0	98·0	97·5	97·1	104·8	94·0
,, 120 ,, ...	101·5	101·0	132·0	98·0	97·7	98·0	114·2	94·5
,, 135 ,, ...	104·8	103·0	*200·0*	97·9	97·9	99·0	129·3	95·3
,, 150 ,, ...	109·0	104·5	—	97·9	98·0	100·6	*207·0*	96·2
,, 165 ,, ...	114·0	107·0	—	98·0	98·0	102·4	—	97·0
,, 180 ,, ...	122·0	111·3	—	98·0	98·0	105·5	—	98·5
Maximum temp. °C. ...	Fired	Fired	Fired	98·0	98·0	Fired	Fired	115·2
In minutes	197·0	210·0	135·0	240·0	240·0	276·0	150·0	270·0

Table V.

Reference	*C171*	*F243*	*D183*	*E194*	*F67*	*F173*	*G1332*
Nature of oil ...	Olive	Olive	Olive	Olive	Olive	Olive	Olive
Free fatty acids ...	2·91	2·59	4·18	5·31	1·73	1·88	1·43
Iodine value	83·13	83·90	81·89	80·26	82·03	80·52	77·86
Temp. in 60 min. ...	96·0	96·80	96·0	96·5	96·2	97·0	93·1
,, 75 ,, ...	99·5	97·30	97·5	97·0	96·4	98·0	94·3
,, 90 ,, ...	103·0	97·8	98·7	97·9	96·8	98·0	95·0
,, 105 ,, ...	109·7	98·0	99·9	98·8	97·0	98·0	95·0
,, 120 ,, ...	*127·0*	98·0	101·4	99·6	97·0	98·0	95·1
,, 135 ,, ...	—	98·5	103·0	100·5	97·0	97·9	94·9
,, 150 ,, ...	—	99·0	104·0	101·8	97·4	97·9	95·0
,, 165 ,, ...	—	99·9	105·0	103·1	97·8	98·0	95·0
,, 180 ,, ...	—	100·8	106·0	104·2	98·0	98·0	95·0
,, 195 ,, ...	—	101·5	107·5	105·6	98·0	98·0	94·8
,, 210 ,, ...	—	103·3	110·0	107·0	98·0	98·0	94·8
,, 225 ,, ...	—	104·8	112·2	107·0	98·2	98·0	94·8
,, 240 ,, ...	—	106·9	115·5	107·2	98·2	98·0	94·9
,, 255 ,, ...	—	109·1	114·7	107·4	98·3	—	95·0
,, 270 ,, ...	—	111·7	113·7	107·5	98·4	—	95·1
,, 285 ,, ...	—	116·5	112·0	107·8	98·6	—	95·3
,, 300 ,, ...	—	*120·0*	110·0	107·8	100·2	—	95·8
Final temperature °C.	—	Fired	102·0	107·8	102·7	98·0	96·0
In minutes	—	—	480·0	360·0	360·0	240	390·0

Table VI.

Reference	*G1125*	*G1263*	*F0348*	*G1279*	*E1047*	*E0766*	*F0172*
Nature of oil ...	Olive	Olive	Olive	Olive	Olive	Olive	Olive
Free fatty acids ...	3·39	3·45	3·47	3·26	3·53	3·39	3·62
Iodine value	82·39	82·50	81·93	80·59	81·23	83·16	82·50
Temp. in 60 min. ...	99·0	95·0	94·8	94·0	98·0	96·2	97·6
,, 75 ,, ...	99·5	96·5	96·1	94·5	98·5	97·1	98·1
,, 90 ,, ...	100·8	97·2	96·9	97·0	98·9	98·0	99·4
,, 105 ,, ...	104·0	97·1	98·0	99·0	99·2	98·8	101·1
,, 120 ,, ...	109·0	97·0	99·1	100·5	100·0	99·5	103·0
,, 135 ,, ...	120·0	97·4	100·3	114·0	101·0	101·0	106·0
,, 150 ,, ...	200·0	98·0	101·8	118·0	102·5	102·4	109·2
,, 165 ,, ...	—	98·6	*104·0*	*122·0*	103·8	*104·9*	*116·0*
,, 180 ,, ...	—	99·0	106·0	220·0	104·5	107·5	131·0
Iodine value of liquid acids	105·61	93·61	98·24	105·06	97·62	98·63	105·06
Amount of linolic acid in liquid acids ...	17%	4%	9%	16½%	8%	9½%	16½%

Table VII.

Reference	*F118*	*G1332*	*F.M.R.*
Nature of oil	Olive ...	Olive ...	Olive/edible
Free fatty acids	7·80 ...	1·43 ...	0·44
Iodine value	83·82 ...	77·86 ...	83·13
Temp. in 60 min.	100·5 ...	93·1 ...	94·9
,, 75 ,, ...	106·0 ...	94·3 ...	96·2
,, 90 ,, ...	128·0 ...	95·0 ...	96·9
,, 105 ,, ...	— ...	95·0 ...	97·0
,, 120 ,, ...	— ...	95·1 ...	97·2
,, 135 ,, ...	— ...	94·9 ...	97·3
,, 150 ,, ...	— ...	95·0 ...	97·6
,, 165 ,, ...	— ...	95·0 ...	97·8
,, 180 ,, ...	— ...	95·0 ...	98·0
,, 195 ,, ...	— ...	94·8 ...	98·5
,, 210 ,, ...	— ...	94·8 ...	98·9
,, 225 ,, ...	— ...	94·8 ...	99·5
,, 240 ,, ...	— ...	94·9 ...	100·0
Iodine value of liquid acids	107·20 ...	91·02 ...	104·60
Amount of linolic acid in liquid acids ...	19% ...	1% ...	16%

In connection with the analyses and subsequent Mackey tests of the two samples marked F118 and G1332 respectively, it was decided to saponify these oils in the usual manner, together with a sample of edible olive oil, marked F.M.R., and to obtain their respective mixed fatty acids on which to carry out standard Mackey tests.

TESTS UPON OLIVE OIL FATTY ACIDS

Reference	*F118*	*G1332*	*F.M.R.*
Temperature reached after heating for 35 minutes	91·1	87·8	88·5
Time in minutes required to reach 193° Centigrade	72	168	85

From the above it seems safe to assume that the amount of original free acidity in the normal oil plays a comparative part in the rate of oxidation only when the compositions of the olive oils are approximately identical, but where these latter compositions are different the amount of free acidity in the original oil ceases to be any criterion. A result such as this on the actual separated mixed fatty acids appears to confirm the statement of Lewkowitsch ("Oils, Fats, and Waxes," Vol. I., Chap. III.), in discussing the preparation of oleic acid, that "exclusion of atmospheric air, although desirable, is not an essential condition, for the older statements, that oleic acid absorbs oxygen from the air with avidity, are erroneous. These statements are due to the fact that the fatty acids from linseed oil or semi-drying oils were previously termed oleic acid."

Since the above, further tests have been made on similar lines with equally satisfactory results. In each case it has been found that the time taken in oxidation of the mixed fatty acids and the iodine value of the mixed liquid acids are inversely proportional.

IODINE VALUE IN RELATION TO THE MACKEY TESTER

It is perhaps advisable to state here that experiments have been carried out by adding definite amounts, up to 15%, of palmitic acid, as representing a solid acid, to normal olive oil. Mackey tests on these mixtures showed that the rate of oxidation was not materially influenced, although the iodine value diminished *pro ratio.* Although the iodine value is a measure of the unsaturation of an oil, that is, a measure of the comparative number of ethylenic linkages, it does not indicate the relative stability of such linkages; in other words, the iodine value, although indicating the final limit to which an oil can be oxidised (destructive methods excluded), *does not show the general tendency* of an oil to oxidise.

SUMMARY

All temperatures, unless otherwise stated, are expressed in Centigrade degrees.

In no case has the temperature in the Mackey Tester been allowed to exceed 200° Centigrade for obvious reasons.

1—The requirements of oils for wool lubrication have been shown.

2—The nature of and effects upon oils modified by exposure to actual operative conditions have been outlined.

3—The varying amounts of linolic acid glyceride, from negligible to dangerous percentages, in commercial olive oils, have been shown to be

a primary cause of inequalities in the rate of oxidation from a practical point of view.

4—The extended use of the Mackey Tester is shown to provide reliable, direct indications of the degree of unsaturation, and consequently of relative suitability of commercial oils.

5—Practical tests on a working scale have borne out results as shown in the tables herewith.

Discussion

Mr. W. S. Stansfield said Mr. Rhys-Davies quoted Lewkowitsch as saying that "the older statements that oleic acid absorbs oxygen from the air with avidity are erroneous." That was not his experience. He had known instances of goods containing oleic acid being moistened and then dried, and within twelve hours they had fired.

Mr. Pickering (replying on behalf of Mr. Rhys-Davies) said that many sins were attributed to oleic acid for which oleic acid was not responsible. The question was whether it was pure oleic acid. He thought it was somewhere about 1876 that it was discovered that the addition of a certain quantity of linseed oil fatty acids to the distillates enabled the oil manufacturer to carry out his processes more easily, and from that time to the present the resultant oil had been sold as oleic. Unless actual analyses were made of the oil before it was put on to the goods, it was hardly fair to attribute the results to oleic acid.

Mr. J. B. Speakman said the difference in the results obtained might be due to the fact that in the case of the actual goods there was a small quantity of oil spread over an immense surface, whereas in the laboratory there was a relatively large bulk of oil on a small surface.

Mr. Pickering said that, on the other hand, the rate of oxidation on wool was only a fraction of what it was on cotton, and in the Mackey tester cotton was used. Commercial oleic acid was by no means pure oleic acid; in fact, he himself had been unable to prepare pure oleic acid in the laboratory.

Mr. G. E. Cowlishaw said his own experience was that all the commercial oleins contained a certain amount of linolic acid.

Mr. Stansfield said he had hoped that Mr. Rhys-Davies would have illustrated the detrimental effect of the oxidation of oils on wool. In specific cases it was very difficult to prove that the trouble was due to oil.

Mr. Rhys-Davies said the paper was only the first portion of the work he had in hand. He intended dealing with that point later.

Mr. Cowlishaw asked whether any gentleman present could give any information as to the acceleration of oxidation on wool due to the presence of water.

Mr. Speakman said oxidation would not take place unless some water were present.

Mr. Pickering said he had seen some flannel goods stored in a defective warehouse, and at the points where water had come through there was a small circular stain at the top, gradually increasing in size with each layer, until at the bottom the stains were 18 inches in diameter. The goods were in the grease, waiting to go to the finishing. He had not been able to obtain

evidence from the Mackey tester with regard to the effect of water, but in that respect the behaviour of cotton was different from the behaviour of wool; and it was a point well worth examination.

Mr. W. M. Mackey said that so far as the Mackey tester was concerned, one had to be careful not to let steam get into the apparatus. If water got in, undoubtedly it had a quickening effect.

Dr. L. L. Lloyd said that with regard to Mr. Stansfield's point, oleins were often adulterated with cottonseed oil to bring up the saponification figure, and the cottonseed oil was very detrimental to the manufacturer and the dyer. If pieces were scoured with cottonseed oil soap, the soap could not be entirely removed, and the most deleterious effect was noticed if the pieces were afterwards dyed with Coomassie Navy Blue, the dyeing properties of which were very easily modified, giving stain effects and uneven dyeing through the presence of easily oxidisable oil. He did not quite agree with the tests which Mr. Rhys-Davies had made on wool. Petroleum ether ought not to be used for separating the fatty acids.

Mr. Pickering said ether had been used, not petroleum ether.

Dr. Lloyd said he was under the impression that the paper said petroleum ether.

Mr. Cowlishaw said petroleum ether was useful for finding the worst offenders, because it would not touch oxidised fatty acids.

Dr. Lloyd said that as far as the analysis of oil was concerned, reference was made to a paper by Hyland and himself, and in that paper it was stated that the iodine value was of no use, but one must deal with the analysis of the liquid fatty acids, because it was only the liquid fatty acids that could be considered as the means of bringing about ready oxidation. With regard to analysis, it was not necessary to analyse the whole of the oleic acid. It was sufficient to use the bromine precipitation method, and determine the octa and tetra bromines. That reduced the amount of work. His own opinion was that rancidity had nothing to do with oxidation. If butter were kept in a jar fully loaded with pure salt, it would not go rancid for a very long period. On the other hand, if commercial salt containing calcium and magnesium were used, the amount required was at least double that of pure salt. It was known that pure salts prevented bacterial action, and he was pretty certain that rancidity was bacterial decomposition—not an enzyme decomposition, but a bacterial decomposition, because it would take place only in the presence of oxygen.

Mr. Pickering said rancidity would occur if the butter were sealed in a tin.

Dr. Lloyd said it would take place only in the presence of bacteria. If it were sterilised by heating it would remain unchanged.

Mr. Pickering asked what solvent Dr. Lloyd preferred.

Dr. Lloyd said he preferred tri-chlor-ethane.

Mr. Pickering said he had used acetone because it could be used cold and possessed a much lower boiling point.

Dr. Lloyd said if one kept below 80° no harm would be done.

Mr. Stansfield said he quite agreed with what Dr. Lloyd had said about mixing cottonseed oil with oleins. Cottonseed oil and cottonseed soaps were the most harmful commodities that had ever been introduced into the

textile trades. Some fifteen or twenty years ago, when Bradford was doing a very big trade with the United States in mohair brilliantines and lustres in cream, large quantities of goods were shipped in tin-lined cases, and on arrival the cotton had completely carbonised and fell away in the form of dust. The goods had been stoved, and the defect—which cost Bradford thousands of pounds—was due to the presence of a slight quantity (about 0·3%) of fatty acid from cottonseed oil soap.

A vote of thanks was accorded Mr. Rhys-Davies for his paper and Mr. Pickering for reading the paper, on the motion of Mr. Stansfield, seconded by Mr. A. Mitchell Bell.

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22—THE CHEMICAL ANALYSIS OF COTTON
xiii.—SCOURING LOSSES

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I.—INTRODUCTION AND SUMMARY

Considering the importance of the loss in weight incurred by cotton on scouring, it is surprising to find so little accurate information in the literature. Isolated measurements, for which, however, essential details are almost invariably lacking, have been quoted by Hunger,[12] who found losses in weight of 3·5 and 4% on boiling cotton for a quarter of an hour with 2·5 and 10% sodium hydroxide solutions respectively; by Dreaper,[6] who found losses of 4·4 and 6·7% on boiling cotton for one-half and one hour with 1% sodium hydroxide, and of 5·1 and 7·3% on increasing the concentration to 2·5%; by Knecht,[14] who has stated that on scouring with lime at 35 lbs excess pressure a yarn lost 2·5%, further alkali boiling followed by a chemic increasing the loss to 4%; and by Huebner,[11] who has expressed the opinion that the scouring loss of Sea Island cotton is as little as 3%.

Trotman and Pentecost,[17,18] pointed out the necessity for accurate moisture controls, and cited figures which refer, presumably (since no conditions are given), to scouring without pressure; these indicate losses of from 3·9 to 5·3% for American yarns, and 4·3 to 6·5% for Egyptian yarns, and show a fall in the scouring loss with increasing yarn counts, but as there is no indication that the same cotton was used throughout, no significance attaches to them in this respect. They concluded, further, that potassium hydroxide was more effective in equivalent concentration than sodium hydroxide, which in turn was more effective than sodium carbonate, sodium borate, or sodium silicate, the efficiency decreasing in this order, the losses in a series of comparative experiments being as follows—

Potassium hydroxide	5·0%
Sodium hydroxide	4·4%
Sodium carbonate	3·7%
Sodium borate	2·8%
Sodium silicate	2·4%

The loss in weight on technical bleaching has been placed at 5% by de Puyster,[16] at 7·3% by Jecusco[13] (6·4% being lost by an alkali boil at 15 lbs excess pressure), and at 6·5% by Higgins.[10]

In previous communications,[1,2,3,5,7,8] the chemical properties of yarns and fabrics scoured technically under various conditions have been described.

It remained therefore to correlate these changes with the losses in weight incurred, which could be determined with accuracy only in the laboratory. The applicability of the results to industrial conditions could then be gauged by a comparison of the properties of the products with those of materials scoured technically. Such experiments have now been made in a small experimental kier designed by Messrs. Mather & Platt, Ltd. Using typical American (36s Texan), Egyptian (2/50s Sakel), and Indian (20s Broach) yarns, the caustic boil has been studied in considerable detail, whilst comparative experiments have been made with the two other alkalis commonly employed—lime and sodium carbonate. Further, the behaviours of a number of typical cottons have been compared under standard conditions. In all cases the scouring loss, and the chemical properties of the scoured samples (residual wax, absorption of Methylene Blue, and copper number) have been determined, and their appearances compared.

The results may be summarised briefly as follows—

(1) Under conditions which reproduce the effects of normal technical pressure boiling with sodium hydroxide, different varieties of cotton lose from 6 to 9% in weight, American cottons generally showing the lowest losses and native Indian the highest, Egyptian cottons coming intermediately. There is therefore removed from cotton during normal pressure boiling from 3 to 4% of material which is unaccounted for by wax, nitrogenous constituents, mineral matter, or substances other than these which are removed by cold water or cold dilute mineral acids. A markedly higher value than 9% has been noted only in one instance—that of Pima cotton, which loses 11·5% in weight and is in this, as in many other respects, abnormal.

(2) The greater part of this material is removed on boiling without pressure, increase of temperature from 100° C. to 140° C. (that is, an excess pressure of 40 lbs) causing only fairly small changes in the scouring loss which are not necessarily greater (and indeed in the cases which have been studied in detail are actually smaller) for cottons recognised technically as difficult to scour satisfactorily than for those which require less vigorous treatment. Increase in the concentration of the alkali is almost as important a factor as increase in temperature, so far as the elimination of non-cellulose constituents is concerned.

(3) The scouring losses mentioned under (1) do not include the whole of the material in cotton which is less resistant than "normal" cellulose to the action of alkalis, and more drastic conditions of treatment cause a further increase in the scouring loss. For example, the loss is from 1 to 2% greater when 3% sodium hydroxide is used at 40 lbs excess pressure than when a 1% solution is used at 20 lbs.

(4) The loss in weight on scouring with lime is lower than that caused by sodium hydroxide in equivalent amount, treatment with lime at 20 lbs excess pressure, for example, causing a loss in weight approximately equal to that occasioned by sodium hydroxide without pressure. Contrary to previous suggestions, therefore, the effect of lime is, in this respect, much closer to that of sodium hydroxide than to that of water.

(5) The loss in weight on scouring with sodium carbonate is only slightly lower than that caused by sodium hydroxide in equivalent concentration.

The removal of wax, reducing substances, and coloured impurities is rather less effective, but the absorptions of Methylene Blue are often a little lower.

(6) The effect of water at 20 lbs excess pressure, as measured by the scouring loss and the chemical properties of the scoured material, is substantially that produced by sodium hydroxide at a much lower temperature—50° C.—but the colour of the water-boiled yarns is markedly darker.

(7) For treatments with sodium hydroxide, the absorption of Methylene Blue affords a qualitative measure of the scouring loss, the changes being greatest for temperatures below 100° C. At temperatures of 100° C. to 140° C., however, and for concentrations of sodium hydroxide from 0·5 to 3%, the changes in absorptive power, though relatively smaller, follow very closely those of the scouring loss. In this range, for equal changes in the scouring loss, the fall in Methylene Blue absorption is greater for cottons with high than for those with lower absorptive power. As a measure of the scouring loss and of the chemical purity of the scoured material, Methylene Blue absorption is not quite so reliable for treatments with lime or sodium carbonate as for treatment with sodium hydroxide, particularly for cottons with high absorptive power.

(8) As a measure of scouring efficiency, the copper number is only sensitive when the scour has been carried out below 100° C. At this point it has already reached an extremely low value.

(9) In the present experiments, the elimination of wax follows the scouring efficiency. In technical yarn scouring, however, the removal has been shown to be small and variable,[7] so in practice the value of the test as a measure of scouring efficiency is largely confined to cloth bleaching, where the changes are greater and more regular. In this case, measurements of Methylene Blue absorption and residual wax are complementary and mutually confirmatory.

II.—COLLECTION AND DISCUSSION OF RESULTS

Standardisation Experiments

In order to correlate the present work with industrial practice, the results obtained with the experimental kier have been compared with those found on a large scale.

Preliminary experiments showed that the results obtained with fabrics were in accord with those observed technically, save that the removal of fat and wax was less efficient. This was found to be due to variations in the preliminary treatment. Comparative tests were made therefore on material which had been singed and steeped technically, the chemical properties of the fabric being compared after (*a*) boiling for six hours at 20 lbs excess pressure with 1% sodium hydroxide in the experimental kier, and (*b*) after a normal technical alkali boil at 30 to 40 lbs excess pressure. The results are given in Table I and show only very slight variations such as might be anticipated from the rather higher pressure employed in the large-scale trials.

With yarns, the reverse effect was observed with regard to the wax, for whilst the Methylene Blue absorptions and copper numbers were in good agreement with technical practice, the removal of wax was invariably more

efficient. In the laboratory experiments, however, a preliminary wetting-out boil had been given with a 0·2% solution of soda ash, whereas it is unusual to give any preliminary treatment industrially, and when this was omitted the results agreed more closely. Typical figures are given in Table II. The preliminary treatment was included in comparative experiments, however, to ensure uniform scouring.

In general, therefore, the performance of the experimental kier appears to be in reasonable accord with large-scale practice, so that the scour at 20 lbs excess pressure, with 1% sodium hydroxide, which has been taken as a standard, may be assumed to represent the effect of an efficient technical pressure scour, so far as the removal of non-cellulose material and the concurrent alteration in the chemical properties of the cotton are concerned.

Table I

Comparison of Technical and Experimental Scours on the same Cloth

Process	Properties of Scoured Cloth		
	Wax %	Methylene Blue absorption	Copper Number
Technical acid steep followed by experimental scour	0·22	0·92	0·01
,, ,, ,, technical scour ...	0·27	0·87	0·04
Technical malt steep followed by experimental scour	0·22	0·97	0·02
,, ,, ,, technical scour ...	0·20	0·90	0·04
,, ,, ,, acid steep, experimental scour ...	0·18	0·90	0·02
,, ,, ,, acid steep, technical scour	0·21	0·84	0·04
Experimental acid steep followed by experimental scour	0·20	0·87	0·03

Table II

Comparison of Technical and Experimental Yarn Scours

Sample and Treatment	Properties of Scoured Yarn		
	Wax %	Methylene Blue absorption	Copper Number
149 Texan 36s—			
Technical scour, 20 lbs	0·37	0·94	0·03
Experimental scour, 20 lbs	0·20	0·86	0·01
,, ,, without preliminary wetting out ...	0·29	0·96	0·03
147 American 20s—			
Technical scour, 15 lbs	0·44	0·96	0·03
Experimental scour, 20 lbs	0·26	0·90	0·04
141 Broach 20s—			
Technical scour 15 lbs	0·39	1·56	0·04
Experimental scour, 20 lbs	0·28	1·47	0·05
,, ,, without preliminary wetting out ...	0·30	1·50	0·03

The Scouring Losses of Typical Cottons

It has been shown in the preceding section that treatment in the experimental kier for six hours at 20 lbs excess pressure with 1% sodium hydroxide yielded results comparable with efficient technical caustic boiling. In determining therefore the scouring losses of a number of typical cottons these conditions have been employed. The results (Table III) show that American cottons lose between 6 and 7% in weight, Egyptian between 7 and 8%, South American between 6 and 8%, native Indian between 8 and 9%, and the one Sea Island sample examined approximately 6%. In all cases the analyses of the products are characteristic of well-scoured cottons of the different varieties enumerated. Of two Indian-American samples included, one has a scouring loss typical of American cotton and the other a higher loss in the Indian range, but in both cases the analytical data for the scoured products are characteristic of American cottons. Pima cotton is quite abnormal, losing 11·5% in weight; even then the Methylene Blue absorption is very high for an Egyptian cotton or a cotton of Egyptian origin, the copper number, though small, is the highest recorded in the series, and the amount of wax remaining is abnormally high, as might have been anticipated from the amount initially present (1·5%). In general, however, the results indicate that the more detailed information recorded for three cottons—American (Texan), Egyptian (Sakel), and Indian (Broach)—covers the normal range of cottons used in the industry.

Table III

Scouring Losses of Typical Cottons on Treatment with Sodium Hydroxide (1%) for 6 hours at 20 lbs Excess Pressure

Description of Sample	Scouring loss (per cent.)	Properties of Scoured Cotton		
		Wax %	Methylene Blue absorption	Copper Number
American—				
212 Memphis, 20s	6·0	0·23	0·90	0·007
154 Salsbury, 50s weft	6·7	0·31	0·88	0·024
149 Texas, 36s weft	6.8	0·21	0·89	0·012
S. American—				
150 Tanguis, 2/50s	6·4	0·21	1·28	0·027
153 Peruvian Mitafifi, 2/50s	6·9	0·22	0·93	0·017
152 Long-staple Brazilian, 2/50s ...	8·1	0·33	1·01	0·022
Egyptian—				
133 Uppers, 2/50s	7·1	0·25	1·18	0 026
148 Sakel, 2/50s	7·5	0·26	1·21	0·010
140 White Abassi, 2/40s	7·7	0·32	1·06	0·01
W. Indian—				
92 Sea Island, 36s	6·3	0·39	1·05	0·024
Indian-American—				
198 Cambodia, 28s weft	6·2	0·24	1·00	0·014
192 Gadag, No. 1, 20s weft ...	8·6	0·29	1·03	0·005
Native Indian—				
194 Sircar, No. 14, 20s weft ...	8·3	0·25	1·75	0·017
201 Surat, No. 1027 ALF, 34s ...	8·5	0·35	1·23	0·006
141 Broach, 20s weft	8·5	0·28	1·47	0·016
Egyptian, grown in Arizona—				
151 Pima, 2/50s	11·5	0·82	1·48	0·036

Table IV—Scouring

Treatment	American (Texan) Yarn 149			
	Scouring loss (per cent.)	Properties of Scoured Cotton		
		Wax %	Methylene Blue absorption	Copper Number
Series 1. *Temperature varied*—				
Caustic soda, 1%, for 6 hours at—				
122° F. (50° C.)	4·1	0·49	1·64	0·16
212° F. (100° C.)	5·2	0·36	1·10	0·03
241° F. (116° C.). 10 lbs excess pressure	6·9	0·21	0·95	0.01
257° F. (125° C.), 20 lbs ,, ,,	7·0	0·20	0·86	0·01
273° F. (134° C.), 30 lbs ,, ,,	7·2	0·18	0·82	0·005
286° F. (141° C.), 40 lbs ,, ,,	7·1	0·17	0·83	0·002
Series 2. *Time varied*—				
Caustic soda, 1%, at 20 lbs for 2 hours	6·6	0·30	0·93	0·02
,, ,, ,, 4 hours	6·7	0·22	0·85	0·01
,, ,, ,, 6 hours	7·0	0·20	0·86	0·01
,, ,, ,, 12 hours	7·1	0·23	0·81	0·003
Series 3. *Concentration varied*—				
6 hours, open kier (212° F.) (100° C.),				
with—1% caustic soda	5·2	0·36	1·10	0·03
2% ,, ...	6·3	0·26	0·95	0·005
3% ,, ...	6·4	0·19	0·91	0·005
6 hours at 20 lbs., with 0·5% caustic soda	6·7	0·20	0·89	0·03
,, ,, 1·0% ,,	7·0	0·20	0·86	0·01
,, ,, 2·0% ,,	7·0	0·28	0·81	0·01
,, ,, 3·0% ,,	7·3	0·24	0·80	0·01
6 hours at 40 lbs., with 1% caustic soda	7·1	0·17	0·83	0·002
,, ,, 3% ,,	8·1	0·32	0·70	0·006

The Caustic Boil

In studying the effects of varying the conditions of treatment of cotton with sodium hydroxide, three typical cottons—an American (Texan) 36s yarn, an Egyptian (Sakel) 2/50s yarn, and an Indian (Broach) 20s yarn—have been employed, and the scouring losses and changes in the chemical properties of the products determined for a range of conditions likely to arise in normal industrial practice; the results are shown in Table IV.

Scouring Losses

It is at once evident that the greater part of the non-cellulose material is eliminated by open kier boiling at 100° C. Thus, considering the series of experiments in which temperature alone was varied, the American cotton lost 5·2% in weight at 100° C., as against 7·1% at 141° C. (40 lbs excess pressure), the Egyptian 6·8 as against 8·6%, and the Indian 7·7 as against

Experiments with Caustic Soda

Egyptian (Sakel) Cotton 148				Indian (Broach) Yarn 141			
Scouring loss (per cent.)	Properties of Scoured Cotton			Scouring loss (per cent.)	Properties of Scoured Cotton		
	Wax %	Methylene Blue absorption	Copper Number		Wax %	Methylene Blue absorption	Copper Number
4·7	0·53	1·74	0·28	6·0	0·42	1·93	0·19
6·8	0·40	1·40	0·06	7·7	0·37	1·69	0·05
7·7	0·25	1·22	0·02	8·1	0·29	1·47	0·02
8·0	0·26	1·11	0·01	8·5	0·28	1·47	0·02
8·6	0·20	1·04	0·01	8·6	0·24	1·42	0·01
8·7	0·21	0·99	0·002	9·0	0·22	1·39	0·01
7·8	0·29	1·16	0·02	8·1	0·34	1·47	0·02
7·9	0·26	1·08	0·01	8·2	0·28	1·47	0·02
8·0	0·26	1·11	0·01	8·5	0·28	1·47	0·02
8·3	0·25	0·97	0·003	9·0	0·27	1·32	0·02
6·8	0·40	1·40	0·07	7·7	0·37	1·69	0·05
7·3	0·26	1·31	0·02	8·0	0·26	1·53	0·006
7·5	0·21	1·15	0·005	8·1	0·26	1·44	0·005
7·8	0·29	1·23	0·03	8·1	0·31	1·61	0·03
8·0	0·26	1·11	0·01	8·5	0·28	1·47	0·02
8·2	0·28	1·02	0·01	9·0	0·29	1·39	0·01
8·5	0·26	0·90	0·01	9·1	0·30	1·26	0·01
8·6	0·21	0·99	0·002	9·0	0·22	1·39	0·01
9·6	0·33	0·82	—	10·4	0·29	0·96	0·03

9·0%. The removal at the lower temperature is not, of course, wholly attributable to the action of the alkali, for the American cotton contained 2·4, the Egyptian 3·1, and the Indian 3·3% of material soluble in cold water, the losses on open kier boiling due to the alkali being therefore 2·8, 3·7, and 4·4% respectively. Thereafter the losses occasioned by increasing the temperature to 141° C. are respectively 1·9, 1·8, and 1·3%, so that the effect of excess pressure is most marked in the case of the American cotton with the smallest total scouring loss, and least in that of the Indian, with the greatest. Whilst, however, the loss in weight increases continuously with rise in temperature with the Egyptian and Indian cottons, it is practically constant above 116° C. with the American.

The experiments at 20 lbs excess pressure, in which the time of treatment alone was varied, indicate that the greater part of the non-cellulose material

is eliminated easily and rapidly, further changes being relatively slight. continuous, and similar in character to those observed in the experiments in which the temperature was varied. Thus, the result attained by boiling for six hours at an excess pressure of 40 lbs is reproduced at the end of 12 hours at the lower pressure, so that the effect of the higher temperature is principally to hasten the small, though significant, changes distinguishing cotton scoured under pressure from that scoured in the open kier.

The effect of increasing the concentration of alkali at a constant excess pressure of 20 lbs is apparently very similar, for the changes observed are small, progressive, and confined principally to the more facile removal of small amounts of relatively stable substances distinguished analytically by their absorptive capacity for Methylene Blue. Thus, the effect of the scour with 1% sodium hydroxide for 12 hours at 20 lbs, or six hours at 40 lbs, is attained in six hours at 20 lbs by increasing the concentration of the alkali to 3%.

Without pressure, the effect of the concentration of the alkali is more marked, and the experiments indicate that increase in the concentration of the alkali is almost as important a factor as increase of temperature so far as the elimination of non-cellulose constituents is concerned.

In the last experiment shown in each table, the temperature and concentration of alkali have been simultaneously raised to the maximum used during the experiments. The result is seen in a further increase in the scouring loss and a corresponding decrease in the absorptive capacity for Methylene Blue. The conditions are such as to depress emulsification of the wax, which is less thoroughly removed than when the concentration of alkali is lower.

The principal conclusions to be drawn from the scouring losses are therefore—(1) That the effect of increasing temperature over the range 100–140° C. is marked only by small increases in the scouring losses of the cottons; (2) that these increases are not necessarily greater, and in the present experiments are actually smaller, for cottons recognised technically as difficult to scour satisfactorily than for cottons which require less vigorous treatment; and (3) that the effect of increasing the concentration of the alkali is almost as marked as that produced by increase of temperature.

Changes in Analytical Characteristics

Copper Number—It will be shown in a later communication that one effect of treating raw cottons with cold water or cold dilute mineral acids is to eliminate the substances responsible for the greater part of the reducing power. Generally, the copper number after such treatment varies between 0·3 and 0·5. From this value it falls practically to a minimum on treatment with caustic soda at 100° C., whilst thereafter the changes are very small, so that as a measure of the effect of scouring the determination of copper number is of value only for temperatures up to 100° C.

Methylene Blue Absorption—In comparing the Methylene Blue absorptions of grey and scoured yarns, the quantity of cotton employed in the determinations must be reduced, as otherwise the end concentrations are so small when the absorption is high that serious errors result. For this purpose 0·5 gram is a suitable quantity to employ in place of the usual 2·5 grams. Using these conditions, the absorption by the grey yarns is

unaffected by the elimination of the constituents soluble in cold water, so that the changes measure solely the effect of subsequent treatment with the alkali. Figures obtained using this modification of the normal procedure are given in Table V, and show that the changes in absorptive power caused by alkali boiling are much greater below 100° C. than they are at higher temperatures, so that absorption of Methylene Blue reflects the scouring loss most sensitively within this range. Nevertheless the measurements recorded in Table IV show that over the range 100–141° C., and with concentrations of sodium hydroxide solution between 0·5 and 3%, the changes in the scouring losses of the three cottons are reflected fairly accurately by the changes in the absorption of Methylene Blue. These are relatively greater for cottons with high than for cottons with lower Methylene Blue absorptions; in other words, for equal additional losses in weight, the fall in the absorption of Methylene Blue is greater for the Indian than for the Egyptian yarn, and greater for the Egyptian than for the American. The additional material removed by the pressure boil from American cotton is therefore, in the mass, less absorbent than that removed from the Egyptian cotton, which in turn is less absorbent than that removed from the Indian.

Table V

Methylene Blue Absorptions, determined on 0·5 gram samples

Treatment	Methylene Blue absorption		
	Texas 149	Sakel 148	Broach 141
Grey	5·40	5·89	5·90
Steeped in water	5·40	5·77	5·84
Scoured at 50° C. (122° F.) with 1% caustic soda	2·43	3·13	3·33
,, 100° C. (212° F.) ,, ,,	1·40	1·88	2·32
,, 20 lbs, with 1% caustic soda ...	1·10	1·43	2·00
,, 40 lbs, with 3% ,, ...	1·00	1·15	1·50

Wax—In the present experiments, the changes observed in the wax content follow roughly those of the scouring losses, save when the conditions are such as to depress emulsification, and therefore to some extent indirectly measure them. In technical yarn scouring, however, the removal of wax is generally much smaller, and is therefore of relatively little significance as an indirect measure of the scouring loss, but in piece goods bleaching, over the range of conditions normally encountered, the removal of fat and wax is generally in accord with the Methylene Blue absorption, and the measurements mutually check one another.

Colour Changes—Comparison of the shades of the different series of scoured samples shows the same progressive variations as the chemical properties and the scouring losses, increase of time of treatment, temperature, and concentration of alkali all favouring the production of a whiter product. The differences in the whites of the pressure-boiled samples after a standard bleach with an alkaline chemic liquor are, however, slight, and though the permanence of the white to steaming places the samples in the same order

as do the shades of the scoured and acid-washed samples, the maximum variation is relatively slight.

The Water Boil

Although boiling with water under pressure is practised as a means of preparing cotton for dyeing dark shades, there is little information as to the effect of the treatment. The results of earlier workers have been summarised previously[9] and since then it has been shown (*a*) that treatment with water under pressure prior to an alkali boil improves the white finally attained;[7,8] (*b*) that under pressure water removes very little fatty material from yarn or cloth; and (*c*) that the extract obtained by treating an American cotton with water at 40 lbs excess pressure contained mineral matter, a small amount of wax, a partly hydrolysed pectin, a saponin, a tannin, one or more sugars, volatile bases (principally ammonia and trimethylamine), volatile aldehydes and ketones (principally acetaldehyde and acetone), a volatile essential oil, and lower fatty acids (principally acetic and butyric or *iso*butyric acids).[5] The elimination of nitrogenous constituents was rather greater than that caused by cold water or cold dilute mineral acids, but much less complete than that caused by treatment with boiling caustic alkali. In the present experiments (Table VI) the American cotton lost 4·2% in weight, the Egyptian 4·2%, and the Indian 5·3%, the corresponding removals with cold water being 2·4, 3·1, and 3·3% respectively. The removal of reducing substances and of substances causing absorption of Methylene Blue was more complete than with cold water. As determined by analysis, the effect is comparable with that produced by 1% sodium hydroxide at 50° C. (122° F.), though the water-boiled cotton is in all three cases very definitely darker in shade.

The Lime Boil

It is usually stated—apparently on the authority of O'Neill[15]—that the effect of scouring with lime is practically identical with that of treatment with water under similar conditions, save that the fats and waxes are saponified and their removal thus facilitated in the ensuing treatment with soda ash after the lime sour. This view has presumably been reached from considerations of the small effective concentration of the lime and the relatively dark colour of yarns and cloths after the lime boil. It is not, however, confirmed by the present experiments which indicate (Table VI) that, as measured by removal of non-cellulose material and concurrent alteration in the chemical properties of the cotton, lime is a much more effective scouring agent than water, the effect of boiling with lime under pressure being, for example, comparable with that of sodium hydroxide without pressure, save in the elimination of coloured impurities, which is less effective when lime is employed. It should be noted, however, that the relationship between the Methylene Blue absorption after lime boiling and the scouring loss is not identical with that found in the case of the caustic boil. For the American and Egyptian cottons, the scouring loss is rather greater for both the open kier and pressure scours than the absorptions indicate, whilst for the Indian cotton the reverse is the case.

The Soda Ash Boil

No valid comparison appears to have been made previously of the efficacy of sodium carbonate relative to that of sodium hydroxide as a scouring agent. Technical experience indicates that the bottoming, as judged

visually, is less thorough, and the handle of the resulting material softer when the conditions of treatment are comparable, whilst Trotman and Pentecost[18] have stated that the scouring losses are appreciably smaller. In Table VI, the results obtained by treating three cottons with sodium

Table VI

Comparison of the Effects of Water, Lime, Soda Ash, and Caustic Soda

Treatment	Scouring loss (per cent.)	Properties of Scoured Cotton		
		Wax %	Methylene Blue absorption	Copper Number
American Cotton, 149—				
6 hours, open kier (212° F.) (100° C.), with				
0·7% Lime	5·0	0·40	1·22	0·08
1·3% Sodium carbonate	5·1	0·49	1·17	0·08
1·0% Caustic soda	5·2	0·36	1·10	0·03
6 hours, 20 lbs (257° F.) (125° C.) with				
Water	4·2	0·48	1·50	0·17
0·7% Lime	6·1	0·28	1·12	0·09
0·65% Sodium carbonate	7·0	0·32	0·75	0·09
1·3% ,, ,, ...	6·6	0·31	0·87	0·07
0·5% Caustic soda	6·7	0·20	0·89	0·03
1·0% ,, ,, ...	7·0	0·20	0·86	0·01
Egyptian Cotton, 148—				
6 hours, open kier (212° F.) (100° C.) with				
0·7% Lime	6·25	0·37	1·76	0·14
1·3% Sodium carbonate	6·1	0·44	1·33	0·14
1·0% Caustic soda	6·8	0·40	1·40	0·07
6 hours, 20 lbs (257° F.) (125° C.) with				
Water	4·2	0·46	1·96	0·36
0·7% Lime	6·9	0·26	1·50	0·15
0·65% Sodium carbonate	7·5	0·29	1·34	0·06
1·3% ,, ,, ...	7·5	0·29	1·13	0·05
0·5% Caustic soda	7·8	0·29	1·23	0·03
1·0% ,, ,, ...	8·0	0·26	1·11	0·01
Indian Cotton, 141—				
6 hours, open kier (212° F.) (100° C.) with				
0·7% Lime	6·9	0·33	1·71	0·09
1·3% Sodium carbonate	7·1	0·41	1·50	0·09
1·0% Caustic soda	7·7	0·37	1·69	0·05
6 hours, 20 lbs (257° F.) (125° C.) with				
Water	5·3	0·40	1·75	0·21
0·7% Lime	7·4	0·25	1·60	0·14
0·65% Sodium carbonate	8·1	0·31	1·39	0·07
1·3% ,, ,, ...	8·3	0·35	1·46	0·06
0·5% Caustic soda	8·1	0·31	1·61	0·03
1·0% ,, ,, ...	8·5	0·28	1·47	0·02

carbonate and sodium hydroxide solutions of equivalent concentration in the open kier, and of two equivalent concentrations at 20 lbs excess pressure, are compared. In general, the scouring losses are slightly less when soda ash is employed, the removal of wax is rather poorer, and the disappearance of copper reducing power is not quite so complete. On the other hand, the absorption of Methylene Blue is in some cases lower after the treatment with soda ash, so that, as in the case of the lime boil, the proportionality between the scouring loss and the Methylene Blue absorption does not hold so strictly as in the case of the caustic boil. In appearance, the scoured

material is invariably slightly darker in colour than in corresponding experiments with caustic soda, and the white after a standard alkaline bleach is slightly less resistant to steaming.

Approximate Composition of the Non-cellulose Material in Cotton

From the scouring loss of any cotton and a knowledge of the small amounts of mineral, waxy, and nitrogenous constituents still remaining, a *minimum* figure may be deduced for the amount of material other than "normal" cellulose initially present. Of this, the proportions of mineral matter and wax and resin are readily determined, whilst that of the nitrogenous material may be calculated roughly from the nitrogen content. Further, for a number of cottons of different origin the amount of material soluble in cold water has been determined and the proportion of mineral and nitrogenous constituents in this established, so that the amount of water-soluble material, excluding these, is easily calculated. (Incidentally, this includes the greater part of the reducing substances present in the unbleached cotton.) Such figures are deduced in Table VII from the results shown in Table VIII, both for the normal scouring loss at 20 lbs excess pressure with 1% sodium hydroxide, and for the more vigorous treatment at 40 lbs with 3% alkali. They show that the amount of material not included in the groups mentioned above is much greater than is usually supposed

Table VII

Approximate Composition of Non-cellulose Material in Cotton

Sample	Non-cellulose Constituents (per cent.)		Accounted for by				Residue of unknown composition (per cent.)
			Mineral Matter (per cent.)	Nitrogenous Material (N × 6·4) (per cent.)	Wax and Resin (per cent.)	Constituents soluble in water at 25° C. (excluding mineral and nitrogenous matter)	
149 Texan ...	7·3	deduced from scouring loss at 20 lbs, with 1% caustic soda	1·1	1·1	0·5	0·9	3·7
154 Salsbury	7·3		1·3	1·0	0·6	0·8	3·6
150 Tanguis	6·9		1·2	0·9	0·4	1·6	2·8
148 Sakel ...	8·1		1·2	1·7	0·5	1·8	2·9
141 Broach	9·1		1·4	1·6	0·6	1·3	4·2
151 Pima ...	12·6		1·5	2·8	1·5	1·8	5·0
149 Texan ...	8·7	deduced from scouring loss at 40 lbs, with 3% caustic soda	—	—	—	—	5·1
148 Sakel ...	10·2		—	—	—	—	5·0
141 Broach	11·0		—	—	—	—	6·1

and that it accounts for from 3 to 5% of the loss in weight which occurs in normal pressure scouring, and for still more when the treatment is more drastic. The bearing of this on the scouring problem need not be emphasised further than to say that attempts to simplify the scouring process based on the more ready elimination of fatty or nitrogenous constituents leave out of account entirely an important and large group of constituents which are dealt with in normal processing.

Table VIII

Behaviour of Cotton under Scouring Conditions of Increasing Severity

Treatment*	Total Loss	Wax Content	Nitrogen Content	Mineral Matter	Copper Number	Methylene† Blue Absorption
American Cotton, 149—						
Grey	—	0·49	0·194	1·14	1·15	5·49
Water, 25° C. ...	2·4	0·49	0·127	0·02	0·34	5·40
,, 20 lb. ...	4·2	0·48	0·085	—	0·17	1·85
NaOH, 1%, 20 lbs...	7·0	0·20	0·03	—	0·01	1·10
NaOH, 3%, 40 lbs...	8·1	0·32	—	—	0·01	0·95
Egyptian Cotton, 148—						
Grey	—	0·57	0·227	1·2	1·13	5·89
Water, 25° C. ...	3·1	0·57	0·192	0·06	0·53	5·77
,, 20 lb. ...	4·2	0·46	0·133	—	0·36	3·53
NaOH, 1%, 20 lbs...	8·0	0·26	0·03	—	0·01	1·43
NaOH, 3%, 40 lbs...	9·6	0·33	—	—	0·01	1·05
Indian Cotton, 141—						
Grey	—	0·49	0·268	1·4	2·03	5·90
Water, 25° C. ...	3·3	0·49	0·173	0·05	0·42	5·84
,, 20 lbs ...	5·3	0·40	0·108	—	0·21	2·83
NaOH, 1%, 20 lbs...	8·5	0·28	0·03	—	0·02	2·00
NaOH, 3%, 40 lbs...	10·4	0·29	—	—	0·03	1·50

*All treatments include final wash (sour) with dilute acid.
†All measurements made on 0·5 gram of material instead of 2·5 grams, to obtain comparative figures.

III.—EXPERIMENTAL PROCEDURE

In the yarn scouring experiments, the yarn (2–3 lbs) in the form of a chain of hanks was packed evenly in a calico bag fitted to the interior of the experimental kier, so as to prevent contact of the yarns with metal. It was wetted out by boiling for one hour with a solution containing 0·2% of sodium carbonate at 5 lbs excess pressure, when the charge was being prepared for pressure boiling, but otherwise at the temperature of the succeeding boil, then washed and centrifuged, and the kier repacked and the main boil proceeded with. The liquor was heated externally and circulated by means of a centrifugal pump, the ratio of liquor to cotton being approximately 6 to 1. Every precaution was taken to ensure absence of air. At the conclusion of the boil, the spent liquor was replaced by more dilute alkali which was circulated for a short time and in turn replaced by water before the kier was opened. The yarn was then washed thoroughly in cold water, the hanks for loss in weight determinations and other analyses being further soured in dilute hydrochloric acid and again washed thoroughly prior to examination.

With cloth, the same procedure was adopted, save that the preliminary wetting out boil was replaced by a steep. Even packing of the kier was facilitated by the use of a cloth woven with split selvages, by which means a fabric 9 in. in width was obtained.

Determinations of Methylene Blue absorption,[3] copper number,[2] and residual wax[5] were made by the methods already described in detail. For the determination of scouring loss, two or more hanks of each cotton, of known weight and predetermined moisture content, were placed in the

middle of the chain and scoured, washed, soured, and again washed thoroughly as described above, and the dry weight at 110° C. determined. From the figures the loss in weight calculated on the dry weight (110° C.) of the grey yarn was determined.

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23—A TEST FOR MERCERISED COTTON

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It has been noticed that mercerised cotton is more readily acted upon by sulphuric acid than is ordinary cotton, and that sulphuric acid of sp. gr. of 1·375, whilst having no action on cotton, has an appreciable action upon mercerised cotton. Further tests showed that if sulphuric acid, of the strength known to give a crêpeing effect to cotton fabrics (*i.e.* 120° Tw.), was diluted with formaldehyde (40% soln.) until the mixture had a gravity of 75° Tw., the action upon mercerised cotton was much increased, whilst little or no action was apparent with unmercerised cotton. The reagent used for the test is obtained by carefully diluting 320 c.c. sulphuric acid (120° Tw.) with 260 c.c. formaldehyde (40% soln.). This gives a mixture of approximately 75° Tw. The sample to be tested, together with a standard sample known to be mercerised, and a sample of unmercerised cotton is immersed in this reagent for two minutes at the room temperature. The samples are then well washed and neutralised with hot dilute sodium carbonate solution.

The effect of the acid mixture upon the samples is best shown by dyeing them with a substantive dye, and for the purpose of the test, the samples are dyed together in a very dilute boiling bath of Chlorazol Sky Blue GW, made alkaline with the addition of a little sodium carbonate. By comparing the depth of colour produced on the test sample with the colour of the known mercerised and unmercerised samples treated at the same time, it is possible to say with certainty if the sample is mercerised or not, and an approximation of the degree of mercerisation can be obtained.

The amount of dyestuff to be used to give the best results can easily be found from one or two trials, but the author has found that when using a dyebath of such a strength that it will dye the unmercerised cotton to a 0·1% shade (based on the weight of cotton), a well mercerised sample will have a depth of colour equivalent to a 0·8% dyeing.

The increased affinity for dyestuffs is shown with all substantive dyes, but Chlorazol Sky Blue GW has been chosen for the test, as it is much easier to distinguish differences of shades in blues than in other colours. If the sample to be tested is already dyed it may be stripped with sodium hypochlorite or hot alkaline hydrosulphite without affecting the test in any way.

The reagent can be used repeatedly if kept in a stoppered bottle. After standing for some time, polymerisation of the formaldehyde takes place and a certain amount of solid para-formaldehyde settles out. If such a mixture is well shaken before use, the test does not appear to be affected.

The advantages of this test can be easily recognised, as the depths of shade produced can be carefully studied if necessary, without the operator being compelled to decide immediately, whilst comparing samples, the colour of which is continuously changing as in the case of the Huebner test.

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24—A RECORDING EXTENSOMETER

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(British Silk Research Association)

SUMMARY

The paper describes an instrument for studying the properties of textile yarns and fibres. The instrument records photographically the load-extension diagram of the material under test; frictional errors in measurement are thus avoided, and after the application of a small correction a load-extension diagram with rectangular co-ordinates is obtained. The particular instrument described was designed and is used in the laboratory of the British Silk Research Association for studying the elastic properties of the ultimate fibres of silk: the design of the instrument enables methods to be used for manipulating the fibres which do not damage them before the fibre is extended in the instrument. These methods of manipulation are described.

INTRODUCTION

The instrument described in this paper, an improved form of that referred to in a previous paper (Denham and Lonsdale, *Trans. Faraday Soc.*, 1924, **20**, Part II.), was designed specially for the study of the elastic properties of the ultimate filaments of silk, but with obvious modifications, as by the substitution of heavier parts, could be adapted for the study of the elastic properties of more robust fibres and yarns. In its essentials the design of this instrument has proceeded on parallel lines to that described by Shorter and Hall (*J. Text. Inst.*, 1923, **14**, T493), which was designed for the study of wool fibres and of yarns. In both these instruments the fibre under test is mounted so that it is just taut, between two clamps, one vertically above the other, the upper clamp being attached to a spring. The lower clamp is then moved in some predetermined manner, thus producing elongations of the fibre, and the corresponding loads to which the fibre is subjected are measured by the deflection of the spring. Whereas, however, Shorter and Hall's instrument, designed for wool fibres, draws the record with a pen, the record is obtained photographically in the instrument now described. Owing to the relative fineness of the silk fibre and the consequent smaller loads to which it can be subjected as compared with the wool fibre, the frictional errors of a pen-recording system, unimportant in the uses to which Shorter and Hall's instrument is applied, make the employment of such a system inadvisable in studying the properties of the delicate ultimate filaments of silk.

In both instruments the arrangement is such that before the extension of the fibre is begun none of the weight of the lower clamp is sustained by the fibre; a relatively heavy clamp may therefore be used, by which the fibre may be firmly secured without undue manipulation which might tend to strain it.

DESCRIPTION OF THE INSTRUMENT

The essentials of the instrument are shown diagrammatically in Fig. 1. The upper clamp K is hung from one end of a miniature balance beam B

by means of a "fusee" chain, which is flexible, but inextensible under the tensions to which it is subjected here. A taut steel blade S is clamped firmly at each end to a heavy brass mount M, so that its long edges are horizontal, one edge being vertically above the other. The balance beam B bestrides this blade, the long axis of the beam being horizontal and at right-angles to the blade. The blade is 9 cm. long, ·7 cm. broad, and ·015 cm. thick.

A thin vertical pencil of light reflected from a small concave mirror attached to the beam B is focussed on a ¼-plate "Process" photographic plate held vertically in a plate holder attached to a carriage C which runs on rails, its wheels being fitted with ball bearings. The rails and the long edges of the spring S are parallel to the plane of this photographic plate. The lower clamp K^1 of the instrument is fixed to a mount which slides loosely upon two vertical parallel cylindrical guides. This mount is attached to the carriage C by a cord passing through guides; any movement of the carriage produced by lifting one of two weights W attached to it by cords passing over pulleys produces an equal movement of this clamp. The instrument is enclosed in a light-tight box.

MOUNTING THE FIBRES

A method described by W. L. Balls ("Development and Properties of Raw Cotton," page 89; A. & C. Black & Sons, London, 1914) is used. The ends of a fibre are attached by gum to the centres of the short sides of a thin rectangular cardboard frame, the fibre itself being just taut. The short sides of this frame are then gripped by the clamps K K^1, and the long sides of the frame cut away, thus leaving the fibre mounted in the clamps.

If the use of gum is undesirable, one end of the fibre is attached to a small piece of copper wire which is then used as a needle to thread the fibre through the clamps, which, in this method of mounting, are faced with flat plates of "red fibre" (a fibrous insulating material used in the electrical trades). These plates, if ground flat by rubbing them on plate glass with a fine abrasive, grip the fibres firmly without cutting or crushing them.

RECORDING LOAD-EXTENSION DIAGRAMS

When a fibre, mounted in the instrument, is elongated by suitable movements of the carriage C, the tensions to which the fibre is subjected produce torsions of the blade S which cause vertical movements of the spot of light. A curve is thus obtained on the photographic plate, the ordinates of which are proportional to the loads on the fibre and the abscissæ equal to the movements of the carriage and thus to the movements of the lower clamp. After the fibre has been broken a traverse of the carriage produces a reference line of zero load on the plate. Amounts equal to the displacements of the upper clamp have to be subtracted from the abscissæ to get the true elongations of the fibre. These displacements are approximately equal to the linear dimension of the corresponding load ordinates $\times \frac{1}{2}$ a/b—*a* is the perpendicular distance from the axis of the blade to the point of attachment of the fusee chain to the beam B, and *b* is the distance from the mirror to the plate. This correction is small; with a sacrifice of simplicity it could be rendered negligible by replacing the spring S by some load-recording system of small inertia, the deflections of which would be very small for the loads applied. These deflections would be highly magnified.

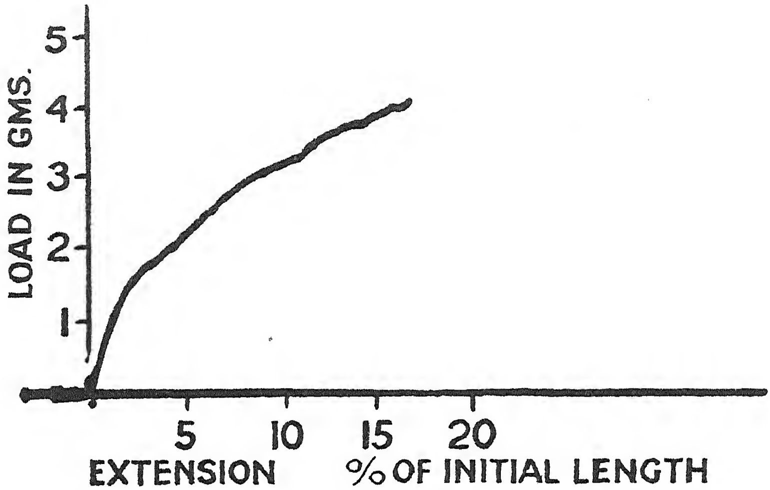

PLATE I

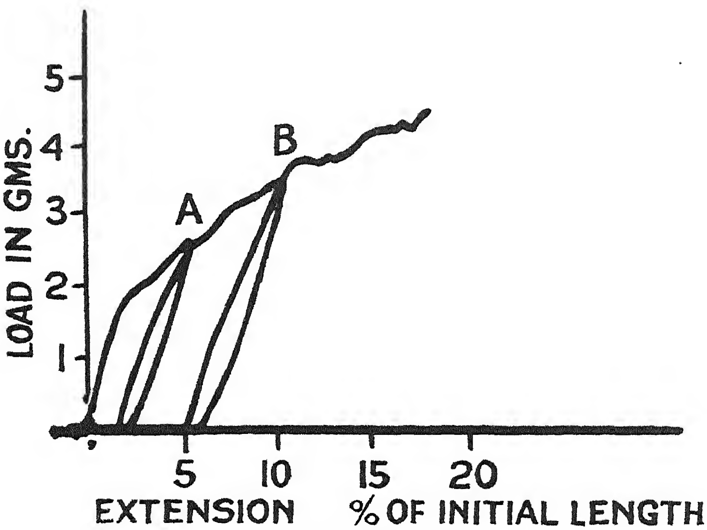

PLATE II

A circular diaphragm is perhaps the simplest of such systems. The errors due to inertia in recording systems have been dealt with by Shorter and Hall (*J. Text. Inst.*, 1923, **14**, T501).

Calibration of the Spring

The spring is calibrated by placing weights of 1 gm., 2 gm., &c., on the upper clamp and recording the corresponding deflections of the spot of light on the plate; a traverse of the carriage C is made after each weight has been put on the upper clamp. An initial traverse gives the line of zero load. A plate is thus obtained upon which are a number of parallel straight lines each corresponding to a known load. This "calibration" plate furnishes the load scale for all the curves obtained by the instrument.

An approximation to a constant rate of elongation of the fibre can be produced when required by connecting one of the weights W to a piston, which is allowed to fall in thick oil contained in a cylinder.

Plate I. shows the experimental curve given by the instrument for a single ultimate filament of mulberry silk, which has been elongated to its breaking point at a constant rate in the manner just described.

In Plate II., the carriage C was moved so that a fibre mounted in the instrument was extended to an amount corresponding to the point A on the curve; it was then moved back until the fibre was slack, and was again moved forward until the fibre was extended an amount corresponding to the point B, the carriage was then moved back until the fibre was slack, and was again moved forward until the fibre was broken. Plate II. shows the curve obtained.

The fibre shows post-elastic hysteresis; Plate II. indicates the potentialities of the instrument in studying such phenomena. The load ordinate and extension abscissa have been ruled on each photograph in order to give the curves a quantitative significance.

Testing the Instrument

If this instrument were made sufficiently massive in construction it would be suitable for the study of the properties of yarns and could therefore be tested by using it to elongate and break materials such as metallic wires, which are known to be fairly regular in their properties. The actual instrument, however, now in use in the British Silk Research Laboratory, having been constructed for the study of the properties of single filaments of silk, is, on that account, not sufficiently massive for the loads required for such metallic wires as are readily obtainable, and this actual instrument was therefore tested by means of a spring in the following manner—

Two lengths of fine steel wire, each provided with a hook soldered to its mid-point, were soldered together to form a spring A (Fig. 2). This spring was mounted in the instrument by gripping the hooks (H and H^1) with the clamps K and K^1 respectively, and a load-extension curve was obtained, using the spring A in place of a fibre. The spring A was then removed from the instrument and attached to a spiral steel spring B, as shown in Fig. 2. The system composed of the two springs A and B was then extended in a vertical direction to different lengths and the extensions of each spring were measured. The spiral spring A was removed; weights were hung on the lower end of the spring B and the corresponding extensions were measured. From these measurements and the relation obtained between the extensions of the two springs, the extensions of the spring A were obtained.

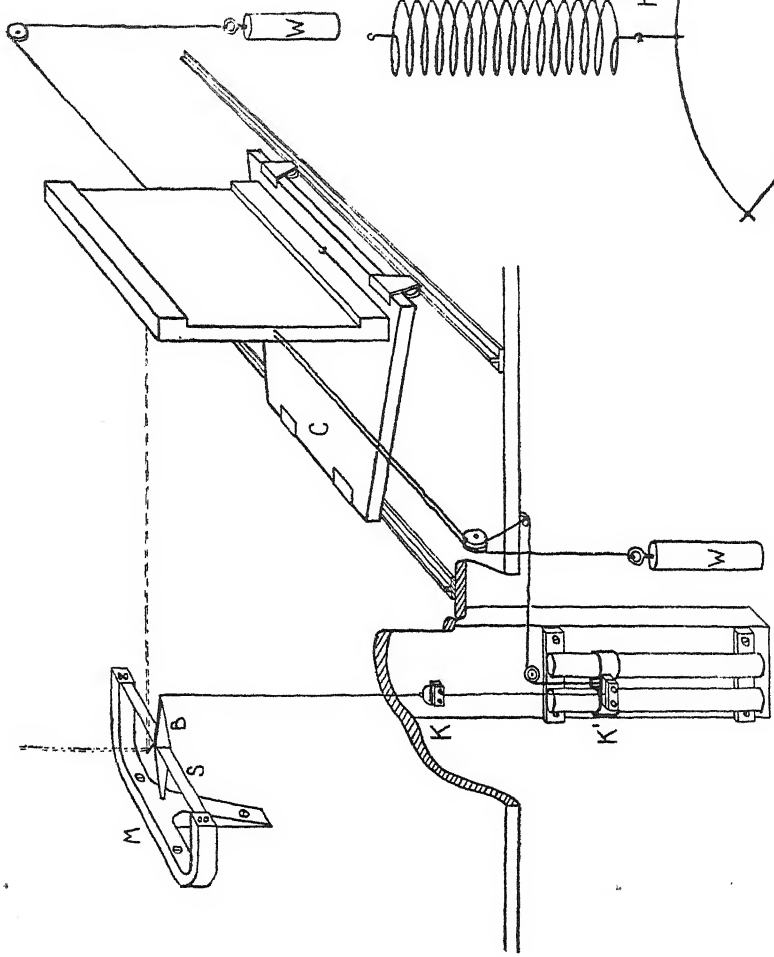

FIG. I

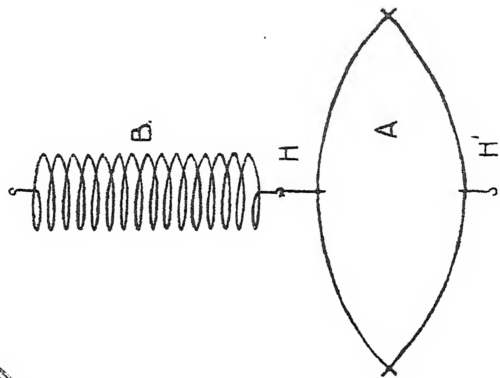

FIG. II

This procedure duplicates in the calibration, the conditions under which the spring is extended in the instrument. The following table gives the results of the test—

Test of Instrument using Spring A

Load-extension Values obtained by Instrument under Test.		Load-extension Values obtained using Auxiliary Spring B.	
1	2	3	4
Extension of Spring A	Corresponding tension	Extension of Spring A	Corresponding tension
·98	1 gm. weight	1·01	1 gm. weight
1·94	2 ,, ,,	2·00	2 ,, ,,
2·80	3 ,, ,,	2·79	3 ,, ,,
3·67	4 ,, ,,	3·61	4 ,, ,,
4·31	5 ,, ,,	4·34	5 ,, ,,
5·06	6 ,, ,,	4·97	6 ,, ,,
5·72	7 ,, ,,	5·67	7 ,, ,,

The figures in column 1 are the extensions of the spring obtained from the load-extension curve given by the instrument for the spring, which correspond to the load scale given by the calibration plate (page 4, "Calibration of the Spring"). The loads in column 4 are interpolated values obtained from the calibration of the spiral spring B and the extensions of the component springs in the systems of springs A and B. The agreement of the figures in column 1 with those in column 3 shows that the indications of the instrument can be relied on to 2%.

25—FABRIC ANALYSIS—THE CONTRACTION OF WARP AND WEFT

By Hiram Hartley
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INTRODUCTION

An analysis of a woven fabric is an attempt to ascertain from a pattern of a finished material the particulars requisite for its reproduction on the loom. Such analysis calls for the application of considerable skill and extensive knowledge on the part of the analyst. The influence of the processes through which the fabric has passed must be appreciated and allowed for if a reasonably accurate analysis is to be secured. Certain particulars, such as counts of warp and weft, threads and picks per inch, finished weight per yard, and the weave employed can be obtained without difficulty from the sample provided. Before, however, any of these can be converted into "loom" particulars, the contraction of the warp threads and weft picks must be ascertained. This paper describes a machine designed to measure this contraction, and the method of application of the machine.

CONTRACTION OF WARP AND WEFT

The contraction of the warp and weft threads is due to two chief causes—

(1) The bending of the threads due to their interlacing when woven.

(2) The shrinkage and movement of the fibres due to the processes of dyeing and finishing, though this is much less marked in cotton yarns than in woollen and worsted yarns.

In measuring the contraction, or actually the extension of warp and weft, the method generally employed is to stamp out a piece of the finished fabric, say 3 in. × 3 in., to pull out several threads of warp and weft, and by placing them on a flat rule to draw out the contraction with the finger and thumb, and to measure the extension as accurately as possible. The objections to this method are—

(1) That the extension of the full 3 in. can only be measured with part of the thread held by the fingers and accuracy of reading is sacrificed.

(2) That the tension applied to each thread must vary owing to the human element.

(3) That the tension applied to yarns of fairly soft twist may cause fibre slip and thereby false elongation of the yarn.

(4) That the application of a steady *even* tension to all the threads tested is impossible.

When contraction has been arrived at by this or some other method, the following "loom particulars" can be obtained—

(*a*) Threads per inch in loom, and the reed width, by direct proportion between the *finished* particulars and the *loom* particulars, as influenced by the measured contraction of the weft threads.

(*b*) Similarly the picks per inch in loom, and the length of the grey cloth can be calculated from the contraction of the warp threads. Thus practically all these particulars depend for their verity on the accuracy with which contraction of warp and weft may be measured.

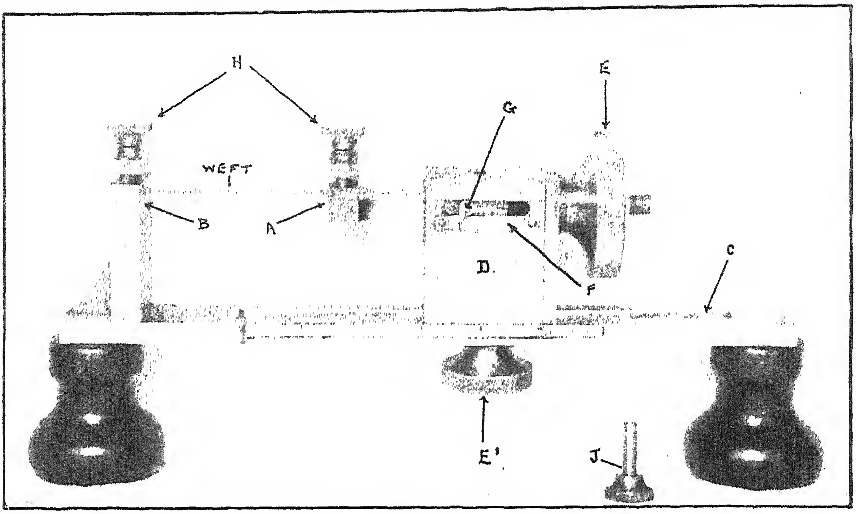

FIG. 1

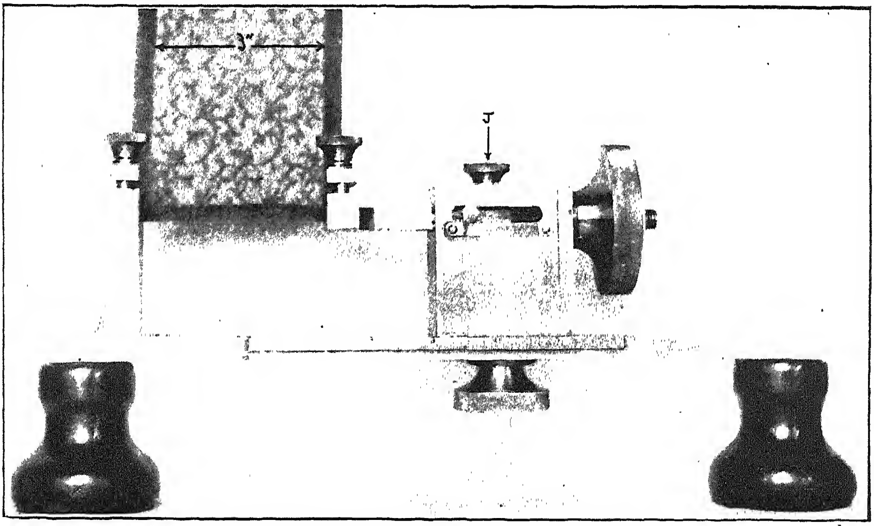

FIG. 2

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NEW MACHINE FOR MEASURING THE EXTENSION OF YARN

This machine* is constructed with two pairs of jaws—A, movable, and B, fixed (Fig. 2). The fixed jaws B are made rigid at one end of the machine and a fixture with the base C. The latter is a flat, slotted plate of $\frac{3}{8}$ in. material, and is graduated on the edge in inches. Moving along the base-plate is the body of the machine D, containing the travelling jaws A, which slide between two slide bars by the aid of a knurled hand-screw E at the end of the body, this also running in guides. The hand-screw E can be rotated in either direction according to the required movement of the sliding jaws. The body of the machine D can also be locked to the base C by a small hand-screw E^1, thus ensuring that when the machine is set at the beginning of the test no movement of the body is possible.

In the body of the machine is a small slot $\frac{3}{16}$ in. wide × $1\frac{1}{4}$ in. long, which allows for the travel of a small indicator-point G, the latter being fixed to the slide holding the moving jaws and registering any extension of the material on a fine graduated scale F on the side of the machine. The jaws of the machine are of the quick-release type, in order to obviate any possibility of the material fouling the jaws in fixing. Both A and B when released are automatically kept open by means of two small springs which are compressed into recesses when the jaws are closed. The latter are tightened and released by small thumb-screws H, and hold material varying in diameter from $\frac{1}{16}$ to $\frac{1}{1000}$ of an inch without possibility of slipping when tension is applied.

In order to ensure accuracy in the reading of the indicator a locking device consisting of a knurled peg J (Figs. 1 and 2), registers through the top of the body of the machine and through the sliding plate containing the travelling jaws A when the indicator G is at zero. This peg J is kept in position until extension of the material is commenced.

METHOD OF EMPLOYING THE MACHINE

The method of using the machine is believed to be quite different from that employed in connection with other machines for the same purpose. The most important point is that the material, when held by the jaws prior to extension, should be at exactly the normal tension of the threads of the finished cloth. If the threads are first removed from the cloth and then placed in the jaws the tension is disturbed. The use of tension weights ensures similar tension in a series of comparative tests but obviously cannot apply the tension present in the finished fabric. To obviate this the following procedure was adopted—If the size of the pattern permitted it (although any size can be tested) a piece of the material $3\frac{3}{4}$ in. wide was cut. Warp threads were then removed from this sample equally at both sides until exactly 3 in. of cloth remained with a fringe of $\frac{3}{8}$ in. of weft at either edge, as shown in pattern in machine in Fig. 1. The machine was then set to test 3 in. of material by sliding the body along the slotted base until its left edge was exactly over 3 in. on the base scale. In this position there is exactly 3 in. between the inside edges of the two jaws when the indicator G is at zero. The body is then locked to the base by means of the small hand-screw E^1 to obviate any movement. The peg J is also inserted to keep the indicator G at zero. About $\frac{1}{4}$ in. of the fringe of the pattern (pick-wise)

* Provisionally patented.

is then inserted in the fixed jaws B, the latter gripping just up to the edge of the cloth. A similar quantity of weft fringe is then inserted in the movable jaws A, which also grip to the edge of the cloth (Fig. 1). Held *between* the edges of the jaws there is now exactly 3 in. of weft at the tension in the finished cloth, the picks lying side by side exactly as in the fabric. By means of a dissecting needle these weft picks (which may number from, say, 6 to 30, according to the sett of the cloth) are then separated from the intersecting warp threads. No difficulty is experienced with this part of the procedure as a rule, but if milled cloths are being tested, the body of the machine can be moved inwards, *once the jaws are clamped*, to assist in the dissection. When the warp has been drawn away a number of weft picks are left firmly held between the two jaws (see Fig. 2), and when the body of the machine is reset at 3 in. on the base scale (if it has been moved), the tension present in the finished fabric has been restored.

The extension of these weft picks may now be tested. The peg J is removed and the knurled hand-screw rotated in a clock-wise direction, causing the travelling jaws A to move slowly away from the fixed jaws B, the extension being registered by the indicator G. The tension on the material should be tested frequently by lightly tapping with the forefinger until the stage is reached where the tension approximates to that imposed by the temples in the loom during weaving. The extension is then read on the scale. When little or no fibre movement has taken place during finishing, as is the case with cotton, art silk, linen, &c., the proportion between the 3 in. tested and 3 in. plus the extension indicated by the machine, is the proportion between the ends per 1 in. in loom and the ends per 1 in. finished. When fibre movement has taken place due allowance must be made for this as indicated subsequently. The number of threads or picks tested at once is immaterial, single threads or any number can be utilised, but a bulk test is preferable, when the extension indicated is the average of the threads tested. One test only for each fabric is necessary. When testing material, such as rayon, single mohair, single longwool, &c., the extension cannot possibly be ascertained by testing individual threads either by hand or mechanically, as the application of tension causes the fibres to slip and the thread pulls apart, but by testing, say, 20 threads together in the manner indicated, sufficient strength is present in the combined threads to enable an accurate reading to be made.

EXPERIMENTAL

A series of cotton, artificial silk, and angola fabrics were first tested. No fibre movement or shrinkage would be present in these cloths with the result that the readings given by the apparatus should, if accurate, give the actual loom particulars for the fabric concerned. In each case the cloths had been made by the writer so that the loom particulars actually employed were available for the purpose of comparison. The weft was tested in each pattern to arrive at the threads per 1 in. in the reed in preference to testing the warp for the picks per 1 in., as the latter is always liable to variation from the number *intended* to be woven, to that *actually* put into the cloth, owing to the setting-up of the loom and other factors, whereas the threads per 1 in. in the reed are known and cannot vary. A variety of styles was employed in order to test the machine under different conditions. The results were as shown on following page.

Table I.
Cotton, Artificial Silk, and Angola Yarns

Style	Material and Count	Warp or Weft	Ends per Inch Finished	Length Tested	Extension to	Ends per 1 in. in Reed: Actual	Ends per 1 in. in Reed: Calculated
Figd. Lining ...	2/40 Cotton ...	Weft	74	3″	$3\frac{8}{64}$″	72	71·0
Shaded Lining	2/80 Cotton ...	,,	128	3″	$3\frac{7}{32}$″	120	119·3
Whipcord Skirting ...	2/30 Cotton ...	,,	131	3″	$3\frac{18}{32}$″	110	110·3
Figd. Lining ...	120 den. Art. Silk	,,	124	3″	$3\frac{7}{64}$″	120	119·6
Tapestry ...	1/5 Cotton ...	,,	59	3″	$3\frac{1}{8}$″	56	56·6
Poplin ...	2/80 Cotton ...	,,	44	3″	$3\frac{19}{64}$″	40	40·0
Export Dress Fabric ...	2/80 Cotton ...	,,	124	3″	$3\frac{1}{8}$″	120	119·0
Whipcord Suit	19 sks. Angola ...	,,	104	3″	$3\frac{35}{128}$″	96	95·3

It will be seen that the results obtained were strikingly accurate. In each case the "threads per inch finished" was the average of four tests. The extension was read to $\frac{1}{128}$ of an inch where necessary. The machine can, therefore, be relied upon to give *direct* results where no fibre movement has taken place.

The second series of tests was made upon worsted fabrics carrying a "clear" finish. In this case slight fibre movement was anticipated.

Table II.
Worsted Yarns—"Clear Finish"

Style	Material and Count	Warp or Weft	Ends per inch Finished	Length Tested	Extension to	Ends per 1 in. in Reed: Actual	Ends per 1 in. in Reed: Calculated
Whipcord Suit	2/36 Botany ...	Weft	112	3″	$3\frac{65}{128}$″	96	95·8
Tropical Suit ...	2/48 Botany ...	,,	80	3″	$3\frac{17}{32}$″	68	68·0
Tropical Suit ...	2/48 Botany ...	,,	68	3″	$3\frac{14}{32}$″	60	59·3
Twillette ...	2/48 Botany ...	,,	95	$2\frac{1}{2}$″	$2\frac{26}{32}$″	84	84·4
Plain Weave Suit ...	2/48 Botany ...	,,	54	2″	$2\frac{19}{64}$″	48	47·0
2/2 Twill Suit	2/32 Botany ...	,,	70	3″	$3\frac{18}{32}$″	60	59·0

It was found that the fibre movement was not sufficient to affect appreciably the accuracy of the readings. When tension approximating to that present in the loom was applied to the weft, the extension recorded was such that direct loom particulars could be calculated. Botany fabrics were tested in each case, as these were the fabrics where fibre movement was most likely to be present. In the case of cross-bred cloths, the possibility of shrinkage affecting the readings is considerably minimised.

Half-milled, Milled, and Piece-dyed Fabrics

When testing fabrics of these types the fibre movement is sufficient, owing to treatment during finishing, to affect materially the accuracy of the reading supplied by the machine, and due allowance must be made for this factor. The question of such allowance has already had some consideration* and interesting results have been tabulated. In actual mill practice, before measuring the extension of an "unknown" pattern, a "known" fabric similar in quality and, if possible, in structure, could be tested on the machine, and the percentage difference between the reading obtained and the actual loom particulars thus calculated. The "unknown" fabric would then be tested on the machine and a similar percentage allowance made on the reading then given. Accurate loom particulars would thus be obtainable.

The subject is one, however, which affords a large field for further investigation, and the use of an accurate and suitable machine in conjunction with carefully compiled tables showing the percentage allowance to be made on the machine's readings, according to the type of fabric being tested, would result in analysis of an accuracy far in advance of that which now obtains.

The writer wishes to express his sincere appreciation of the assistance and advice rendered him by Mr. R. B. Brigham, of Leeds, in regard to the mechanical details involved.

* "Analysis of Woven Fabrics," Barker and Midgley.

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26—A GRAVIMETRIC METHOD FOR INVESTIGATION OF THE VARIATION AND LEVELNESS OF YARN

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SUMMARY

The paper describes a method for the determination of the local variation or irregularity in count of yarns, by weighing successive short lengths on a special balance. The results show up local irregularities, i.e., both thick and thin places are found. The manner in which these occur along the yarn is investigated. The method is now being employed for the determination of irregularity of short lengths of yarn down to and lengths of one inch, spun under various experimental conditions at Torridon, and also for the investigation of the faults occurring in woven fabrics due to the presence of thick and thin places in the yarn. The figures quoted in the paper are illustrative of the method and refer to lengths of 3·14 in. A table is appended showing the average weight of the lengths, the greatest and least weights observed, and the percentage number of pieces of yarn which may come within safe and unsafe limits as regards showing up as faults in the woven fabric, &c.

INTRODUCTION

In Publication No. 52, W. J. Hall[1] has developed a method for the detection and measurement of variations in yarns by weighing hanks taken direct from the cops. Whilst this shows that the variations from cop to cop in all kinds of commercial woollen yarns are surprisingly large, yet for the purpose of weaving it is certain that the variation of the yarn in shorter lengths is as important, since the occurrence and twits, or thick places, will be almost as objectionable in showing up as defects in the cloth, as the variation of count over greater lengths. Local irregularities may also cause trouble in weaving. Oxley[2] devised a method for testing cotton yarns whereby the yarn was drawn between a metal shoe and a flat plate, and the variations recorded optically. In the case of wool, however, it is doubtful if this method would work accurately, as there is a certain amount of compression of the yarn in passing it between the plates. Taking the softness and compressibility of the woollen yarn into consideration, it is obvious that the true variation would be even more difficult to determine by this method than in the case of cotton, since count, twist, and the volume or bulk compressibility would have to be allowed for in such observations.

Another way was therefore sought and it was decided that a weighing method for short lengths of yarn would furnish the information required. In this case (smaller lengths could be taken if required), the weight of individual successive 3·14 in.* over a considerable length of yarn was measured. In order to accomplish this a special form of micro-balance was devised. The form is essentially the same as that used by Barker and King[3] for the estimation of the weight of single fibres of known length, except that the filament is more robust. The diameter of the phosphor bronze filament in the present experiments was 0·004 in. as against 0·001 in. and 0·002 in. in the more delicate apparatus. The balance was thoroughly tested during use for any creep of zero due to incomplete restoration of the filament to its original position due to residual torsion. This was done by observation of the zero after every ten readings had been completed. It was found that this did not furnish any appreciable error. The balance was carefully calibrated before and after each set of 200 readings were taken, and calibration

* This being the circumference of the 1 in. roller used.

curves were drawn from which the weights of the three inch yarn lengths were interpreted directly. These calibration curves showed little difference from each other, but were necessary in order to compensate for any small variations in the instrument due to temperature or other external agencies. They might possibly have been omitted, but for accurate work they formed an effective safeguard. As before, the observations were taken through a telescope placed approximately four feet away from the balance beam. The readings were taken in the humidity room at 70% Relative Humidity (R.H.) and 72° F. The utilisation of the constant humidity and temperature room ensured that the wool remained in the same "condition" (i.e. moisture content), and also eliminated corrections for change in length of the phosphor bronze filament on the balance with temperature variation.

In order to secure successive lengths of 3·14 in., the yarn was wound on an accurately turned roller of diameter 1 in. The roller was fitted with screws at each end which served to hold a metal bar stretching right across the cylinder. This could be tightened on to the cylinder by means of the screws, and it held the yarn in position after winding. Exactly along one edge of this bar a groove was cut in the cylinder. The procedure was as follows. The yarn was wound on to the cylinder and then fixed in position by means of the bar. A sharp knife furnished by a safety razor blade was passed along the edge of the bar, guided by the groove. This cut the yarn into successive equal lengths which hung as a fringe from the roller. By slackening the end screws the bar was slightly loosened, successive lengths of yarn could be taken in order and weighed separately upon the balance. After weighing the yarn on the micro-balance, the lengths were collected in bundles of 100 and these were carefully weighed on an ordinary chemical balance. The sum of the 100 individual weights agreed with the ordinary balance weight of the whole hundred in general to within less than ¼%, so that the error in weight of an individual length was extremely small. Table I. shows typical results.

Table I.

Yarn Firm	No. of Test Lengths Weighed	Total Wt. from separate Micro-balance Readings	Total Wt. from Chemical Balance	Difference Actual	Difference Percentage
B_2	200	1·5044 gms.	1·5045 gms.	+0·0001	0·006%
D	200	2·7993 ,,	2·8049 ,,	+0·0056	0·200%
J_1	1027	13·8490 ,,	13·8853 ,,	+0·0363	0·260%
J_2	200	2·7735 ,,	2·7737 ,,	+0·0002	0·006%

These are typical of the general agreement found throughout.

The yarns selected for test were those used by W. J. Hall.[1] Between the commencement of this work and the completion of the previous work, the yarns had been wound into cheeses from the bobbins, as these had to be returned to the manufacturers from whom the yarns were obtained. This was unfortunate as rendering the results in the two cases not strictly comparable, yet it was felt that the results now obtained could be put forward as—

(*a*) Indicating a new method for the determination of variations in yarns.

(*b*) Furnishing figures which would enable us to develop a method for the presentation of results.

Firm	Details of Machine	No. of Spindles	Blend	Nominal Count	No. of Tests	Average or Mean Weight, Milli-grams	Greatest Weight, Milli-grams	Per-centage of Greatest Wt. above Mean	Least Weight, Milli-grams	Per-centage of Least Wt. below Mean	A. Average Difference from Mean	B. Standard Deviation (Root Mean Square Deviation)	Ratio A/B	Co-effi-cient of variation (Short Lengths)	Co-effi-cient of variation (Hanks from Hall)
B_2	Breast and 2 Swifts; Scotch feed, 2 Swifts; Single Ring Doffer; 50 Threads	70	Woollen	14 Skeins	600	7·39	8·80	19·08%	6·25	15·43%	0·363	0·455	0·797	6·16%	4·87%
D	5 Small Swifts; Scotch feed, 2 Swifts; Double Ring Doffer; 96 Threads	384	Shoddy, All Wool	18 Skeins	600	12·13	16·45	35·61%	8·50	29·92%	0·775	0·960	0·809	7·91%	4·11%
J_1	2 Swifts; Ball feed, 1 Swift; Scotch feed, 2 Swifts; Series Tape Condenser; 104 Thread	390	50's Cross-bred	13'4 Cut, 10·36 Skeins	1027	13·00	17·50	34·62%	10·27	21·00%	0·860	1·069	0·806	8·22%	4·02%
J_2	Breast and Swift; Ball feed, 1 Swift; Scotch feed, 2 Swifts; Single Ring Doffer; 52 Threads	390	50's Cross-bred	13'4 Cut, 10·36 Skeins	600	13·49	18·00	33·43%	10·72	20·53%	0·803	1·0100	0·795	7·49%	5·28%

Variations from Mean or Average Value **Analysis of Results**

Firm	On Mean	Within 5%		Total within 5%	Between 5% and 10%		Total within 10%	Between 10% and 15%		Total within 15%	Between 15% and 20%		Total within 20%	Between 20% and 30%		Total within 30%	Between 30% and 40%		Total within 40%
		Above	Below		Above	Below		Above	Below		Above	Below		Above	Below		Above	Below	
B_2	Nil	*189*	*166*	*355*	*94*	*96*	*545*	*30*	*17*	*592*	*5*	*1*	*598*	*2*	*Nil*	*600*	*Nil*	*Nil*	*600*
		31·5%	27·6%	59·1%	15·7%	16·0%	90·8%	5·0%	2·8%	98·66%	0·83%	0·17%	99·66%	0·34%	—	100%	—	—	100%
D	Nil	*60*	*86*	*146*	*52*	*98*	*295*	*58*	*69*	*422*	*57*	*52*	*531*	*40*	*24*	*595*	*5*	*Nil*	*600*
		10·0%	14·16%	24·16%	8·67%	16·33%	49·16%	9·67%	11·58%	70·33%	9·50%	8·67%	88·3%	6·67%	4·00%	99·17%	0·83%	—	100%
J_1	*7*	*209*	*202*	*418*	*191*	*102*	*701*	*133*	*48*	*892*	*72*	*14*	*978*	*41*	*4*	*1023*	*4*	*Nil*	*1027*
	0·68%	20·34%	19·68%	40·70%	18·60%	9·93%	69·23%	12·96%	4·67%	86·86%	7·01%	1·36%	95·23%	3·99%	0·39%	99·61%	0·39%	—	100%
J_2	Nil	*156*	*127*	*283*	*89*	*105*	*477*	*44*	*46*	*567*	*10*	*14*	*591*	*7*	*1*	*599*	*1*	*Nil*	*600*
		26·0%	21·17%	47·17%	14·83%	17·50%	79·5%	7·33%	7·67%	94·5%	1·67%	2·33%	98·5%	1·16%	0·17%	99·83%	0·17%	—	100%

Number of Readings in Italics. **Percentage of Total No. of Readings in Solid Type.**

(*c*) Showing the periodicity, if any, of the variations in the yarn tested.

(*d*) Indicating the method to be employed in testing the regularity of yarns to be produced under either standard or varying conditions in the new carding and spinning plant installed at Torridon.

In the case of yarn J_1, 1,027 tests were made, whilst in the case of the other yarns the number was limited to 600 in each case. As typical of the general character and also to establish the validity of the method, results are given for four separate samples of the yarns tested after conditioning in the humidity room. These are all noted in the tables appended, and for purposes of comparison and identification, Hall's results for these yarns are also included. It will be noted that the co-efficients of variation as given by the short length tests are nearly twice those of the hank tests, and, further, that the determination of local variations places the yarns in a different order in the two cases as regards amount of variability. This is what would be expected since in the hank tests long lengths of yarn are dealt with, and variations from the mean, being both plus and minus, would cancel each other out. The same effect could be obtained by adding together several hundreds of three-inch lengths and comparing the total weights.

Table II. shows the average, greatest and least values, and the percentage difference of the two latter from the average. Details of the origin of the yarn are given. The mean deviations are also stated, as well as the standard deviations, and the co-efficients of variation, both in this case and those determined by W. J. Hall for hank-tests on the same yarns. Below this is a table showing—

(*a*) The number of readings between given percentage limits from the average or mean values for all the observations.

(*b*) The percentage of these numbers of the total number of tests.

(*c*) How many of these readings were above and below the mean.

As already pointed out, it is probable that readings within certain limits, above and below the average, are unimportant to the manufacturer as not affecting weaving or finished appearance in the cloth. The exact fixation of these limits has yet to be determined and, of course, the range would differ according to the uses to which the yarn is to be applied. Careful records are now being maintained, information collected, and experiments conducted with a view to the determination of the limits. In ordinary mathematical work a graph can be used to express the method of variation of a series of results, and it is a combination of a graphical method with what is known in statistics as a "histogram" which may probably be used ultimately.

It may be that for a certain purpose the variation of the yarn, up to say 25%, would not matter. The manufacturer would then only care about—

(1) The mean or average value.

(2) The numbers of extreme values beyond the safety limit, which would be likely to show up as faults in weaving or in the finished cloth.

In the particular case under discussion, thick or thin places would be likely to show up to the detriment of the appearance of the cloth, and it is the number of these thick or thin places that would be the criterion for the

usefulness of the yarn. Thus we see that in the yarns under test, the following number are above 30% thicker than the mean value for the yarn—

Yarn	No. of Tests	No. above 30%	Percentage
B_2	600	0	0
D	600	5	0·83%
J_1	1027	4	0·39%
J_2	600	1	0·17%

It may be that 30% is too high a limit. This is a point to be investigated and inquiries are now being instituted in this direction. If a lower percentage is necessary, Table II. shows the figures required.

Periodicity—A search for periodic occurrences in the yarns yielded interesting results. It may be that on account of some action of the machines a certain fault, e.g. thickening, thinning, extra twist, &c., may occur at definite successive lengths along the yarn. In other words, with the machine working perfectly regularly and repeating its operations in definite order, it will be found doing the same thing at even intervals of time. It can be realised, therefore, that if there is any irregularity in its working there will be a fault or variation created at equal intervals of time, and these faults or variations will be found at equal distances apart along the yarn.

As an example, take the mule draw. Each time the thread is drawn out to the same length and there are the same "take-up" actions, drafting, &c., repeated successively. Now, if there is any variation we would expect it to occur at the same place in each draw if the machine is working evenly. These variations, if they constitute thick and thin places in the yarn, would be detected by the present method. In the case of cotton, Oxley found a maximum thickness at the end of each draw, or approximately 70 in. apart. In later work on woollen yarns, H. M. Williams,[4] of Galashiels, found no evidence of this maximum. The present work, however, points to the existence of such maxima. It is also found that subsidiary maxima occur and analysis of the curves shows that these are quite regular in frequency and point of occurrence.

The detailed examination of this factor is now being pursued. As a preliminary note, however, it may be mentioned that there is one high maximum and two subsidiary maxima in each draw in the particular yarns examined. These apparently occur at intervals of approximately 1/3, 2/3, and at the end of the draw length. They may be due to various causes, and Williams has suggested that the yarn behaves as a string vibrating transversely. Variations may also be due to irregular action of the mule itself or to variations of the condenser, but mere surmise on this point is unwise without further investigation. A detailed and carefully planned set of observations and experiments has now been instituted, and the gravimetric method has been sufficiently justified to warrant its use in the investigation.

My thanks are due to my colleague, Mr. A. W. Stevenson, for the development of the cutting roller. The laborious work of calculation, &c., was done by Mr. E. E. Marshall, Junior Assistant.

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27—KEMP

Contributions arranged by the British Research Association for the Woollen and Worsted Industries

Part I.—Introduction.
Flat Kemp.
Part II.—Kemp Fibres in the Merino.
Part III.—Kemp Fibres in the Fleeces of the Welsh Mountain Sheep.
Part IV.—Kemp Fibres in Fleeces of British Breeds of Sheep.
Part V.—Some Characteristics of Mohair Kemp.

PART I.—INTRODUCTION

By H. J. W. Bliss, M.A., F.I.C.
(The British Research Association for the Woollen and Worsted Industries)

The circumstances under which this series of papers were collected may be briefly recorded. The staff of this Association had devoted some attention to the possibility of dyeing kemps, chiefly mohair. Howard Priestman had also some years ago, privately, made a special study of certain features of kemp, particularly of some East Indian varieties. Members of the staff of the Animal Breeding Research Department, Edinburgh, with whom the Association is in very close touch, had been studying kemp both from the micrological and the genetical point of view. Then a short time ago Professor Duerden, in South Africa, published an account of kemp in the merino. It was thought therefore that a good purpose would be served by bringing all this information, both old and new, together in an accessible form, more particularly in view of the fact that the text books give but a poor account, and that Priestman's work appears to have escaped notice.

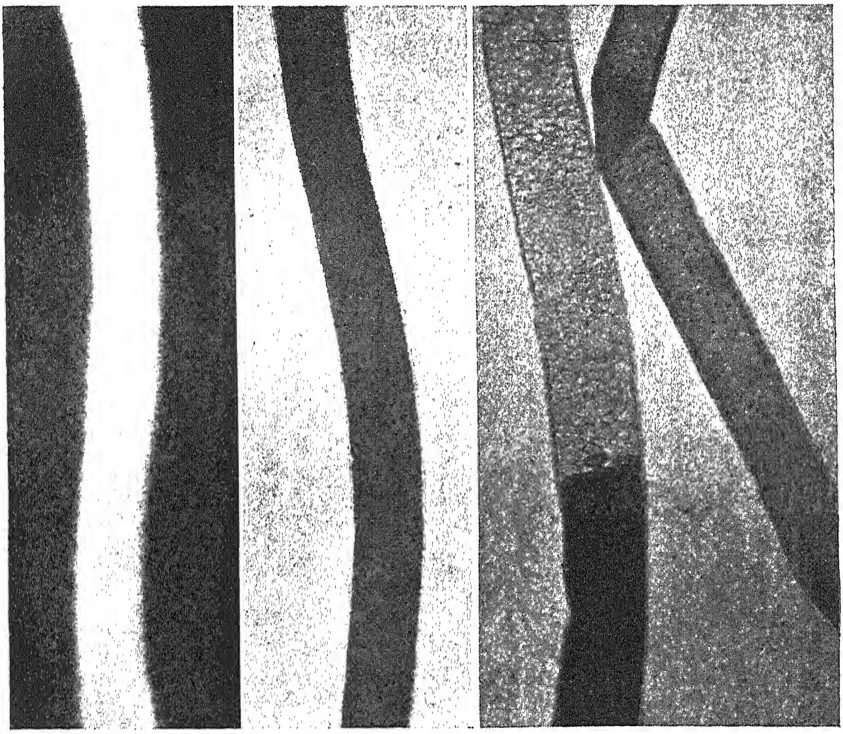
If we turn, for instance, to Matthews' "Textile Fibres" (1924) we find, on the subject of kemp, little but a reference to Bowman's "Structure of the Wool Fibre." Now Bowman seems to have regarded kemp as a malformation of normal wool, which consists in the mildest cases of a fusion of the surface, the disappearance of the projecting scales, and the assumption of an ivory appearance by a short section of the fibre. Such fibres he calls "flat" kemps and he states that they can be dyed with care. In fully-developed kemps, he says that the fibre assumes a much more dense appearance, the "cellular character of the cortical part is entirely obliterated, and the fibre assumes the appearance of an ivory rod without any internal structure being visible." He states that such fibres resist dyeing; that they occur chiefly in certain regions of the body, e.g. on the legs; that they are a sign of want of trueness in breeding; and that they are usually short. His definition therefore comprises first the disappearance of surface markings, secondly the opaque ivory appearance, concealing the internal structure, if any.

Priestman's Work

Priestman (*Yorkshire Observer*, 3rd June and 5th June 1911) went a great deal further, and showed very interesting micro-photographs, some of which are here reproduced with his permission. He showed that the brightness or silveriness of the kemp by reflected light, and its density or opacity by transmitted light, were due to the inclusion of spaces or air bubbles within the fibre, and that if these spaces be filled by soaking in benzene and oil, or by boiling in oil, then the fibre becomes transparent. He disagreed with Bowman's statement that the scales of kemp are fused or non-existent, but declared that under proper conditions (filling the spaces

with a liquid and viewing by transmitted light) they are quite visible. He thought that there may be some cementing substance partly filling their interstices.

An important point is that both Bowman and Priestman seem to have regarded kemp as a faulty wool fibre, and that perhaps sufficient distinction was not drawn between "true" short kemp and kempy or medullated wool.



PART I.—FIGS. 1, 2, and 3 (Priestman)

FIG. 1—Kemp illuminated by direct sunlight.
,, 2—The same kemp illuminated by transmitted light, opaque except at edge.
,, 3—Opaque kemp steeped in benzene until portions are quite transparent.
Taken from same sample as Fig. 2, and with same magnification.

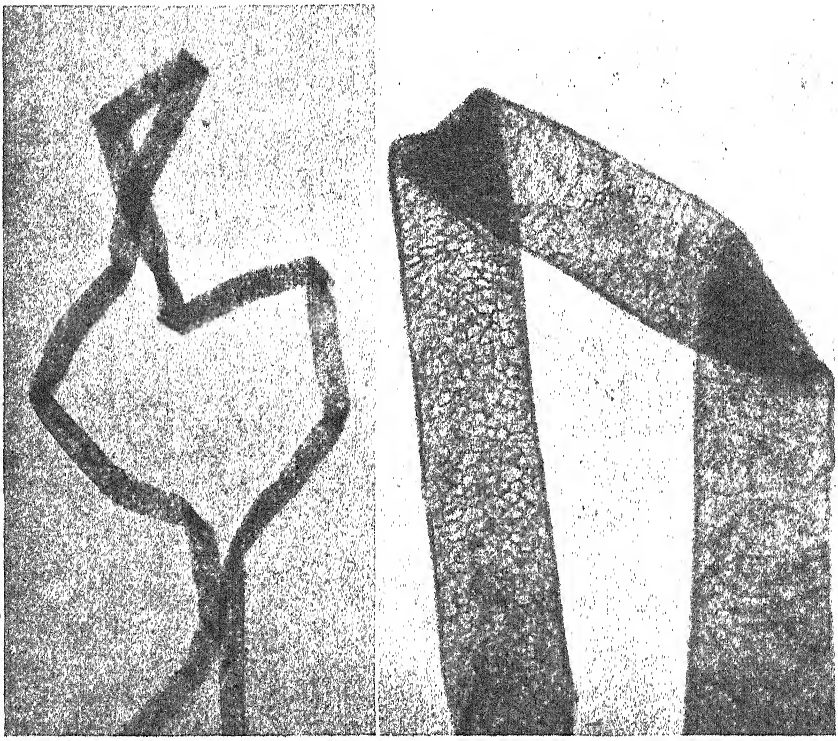
Flat Kemp

Bowman (1908 ed.) refers to "flat" kemp, but a study of his actual words seems to show that he examined incomplete or partial kemps which had a normal (medullated) internal kemp structure. Such kemps can be dyed "with care." Priestman, on the other hand, found a different type of kemp, which fully deserves the name "flat." He first observed these kemps in patterns of cloth submitted for diagnosis, but could not state whence they had come. Later, after a prolonged search among different types of wool, he found this type in certain East Indian wools. Since these kemps do not appear to have been generally recognised, his description is worth quoting somewhat fully.

"Under certain circumstances they will not show in the cloth. On the other hand, they often do show very badly, even when they are thoroughly dyed, simply because they are flat and therefore reflect a great deal of light

when it strikes them at the necessary angle. They show just as an ebony paper knife would show if laid amongst a lot of black pencils. Each pencil reflects a line of light from its curved surface. The paper knife reflects a sheet of light from its whole width.

"In dyed and finished cloth flat kemps generally appear on the surface in a way that makes even competent manufacturers regard them as hemp



PART I.—FIGS. 4, 5 (Priestman)
FIG. 4—Flat kemp like "empty hose-pipe." ×30.
,, 5—Portion of flat kemp. ×80.

or grass. They appear lighter than the rest of the fibres in the pieces, but under the microscope there is little difference in depth of colour. The apparent lightness is due to reflection. Under the microscope they resemble nothing so much as a woven canvas hosepipe which is empty and therefore flat. Their shape prevents all waviness in a horizontal plane, and if they are bent they act exactly as a tape or an empty hosepipe would do, turning over and forming an angle at each bend. In this, of course, they differ entirely from normal wool fibres or from ordinary kemps. It is probably their erratic shape which deceives so many practical men, and were it not for the very obvious way in which the scales show under the microscope it would be extremely hard to identify them as wool at all."

These kemps were uncommon, but occurred from time to time in low serges. They showed most in browns, olives, and greens, were almost invisible "in the grey," i.e. undyed, and were well concealed in navy blues and blacks. Certain kinds of black dyes seemed to swell these fibres up to a nearly round section again.

After a considerable search he found these kemps in an East Indian wool, and their properties were investigated. It was found that they contained air. He suggested that the internal cells of the fibre had contracted greatly (thus admitting air), but had not entirely disappeared, since black dyes again filled out the fibre, which pointed to the presence of some material upon which it could act.

Flat kemps were also observed to float in water (unless boiled to displace the air), while ordinary kemp sank.

Structure of Kemp

Priestman also observed and photographed very clearly the characteristic round or square cells of the kemp medulla (both ordinary and flat), and advanced a theory that these round cells are due to an abnormality in the hair root, which produces these in place of the normal spindle-shaped cells.

Later knowledge (see the following papers) shows that the medulla of true kemp is the product of a special group of cells in the root, and also that it is of annual growth, and a survival of the outer coat of the wild sheep. It is, therefore, scarcely an abnormality.

It seems that there is scope for further study of the medulla, both from the histological and physiological aspects. We have "true" kemp, but we also have partially kempy fibres; we have young animals producing clear wool or hair, and the same animals yielding white (i.e. medullated, air-containing) hair later in life; and we have some that habitually produce partial or discontinuous medulla. If the medulla is of a distinct cellular origin in the skin, and if it is sometimes developed and sometimes suppressed, it is perhaps conceivable that the factors governing its development might be elucidated. The derivation of true kemp from the ancestral outer coat does not seem to cover the whole field.

The Air in Kemp

It is of interest to note that Barker and King, of this Association (*J. Text. Inst.*, 1926, **17**, T53), have recently published work on the specific gravity of wool which gives an indication of the actual air content of the medulla in kemp or kempy wools. Work now in progress also indicates that there is probably some chemical difference between kemp and normal fibre.

PART II.—KEMP FIBRES IN THE MERINO

By Professor J. E. Duerden, M.Sc., Ph.D.
(Rhodes University College, Grahamstown, South Africa*)

In South Africa kemp is known as a straight, coarse, dull, opaque white fibre, found in greater or less numbers mixed with wool. It is rather brittle and non-elastic, and in the process of manufacture does not show the dye like true wool fibres. It is a source of deep concern to the farmer, owing to the depreciation which it causes in the value of the clip, and to the manufacturer from the lack of uniformity in texture and colour which it confers on the finished article.

Practically all merinos show a certain amount of kemp at one period or another. Fibres can usually be found on the head and over the bare patches of the inner side of the legs, while in some sheep they are more or less distributed throughout the fleece. They are easily recognised on account of their coarse, straight, white appearance, and stand out conspicuously against the true wool, the fibres of which are much finer, crimped, and closely arranged in staples. Again, while kemp may be plentiful in certain parts, the fibres are always single and isolated, never in staples, and are intermingled with the denser growth of the wool. Usually they are not more than an inch or two in length and oval in section, not circular like wool fibres. On the face and legs they are always to be found in position, growing from the follicles, but in the fleece they often occur loose, having been shed from the follicles and remained entangled in the staples.

Microscopic Appearance

Examined under the microscope by transmitted light, a ripe kemp fibre has the appearance represented in Fig. 1. At the base it is slightly swollen and frayed out into a number of short delicate fibrils. This represents the root of the hair which has completed its growth, and is ready to be pushed out, or is already shed. Above the root is a clear, transparent part, and beyond this is a black, central core surrounded by a clear margin, and extending nearly the full length of the fibre. For a variable distance towards the tip the fibre is again clear and solid, terminating in a sharp point, as in all hair and wool fibres which have never been clipped. If the same fibre be viewed under the microscope by reflected light on a dark background, the central core, which was black in transmitted light, appears as a silvery white streak down the middle.

Under a high power of the microscope the clear parts towards the root and tip are found to be uniform in structure throughout their thickness. Like true wool the fibre here consists only of solid, fusiform, cortical cells, and an outer serrated cuticle, whereas the remainder of the fibre has an additional thick central core or medulla, occupied by minute air inclusions (Figs. 2 and 3). It is the presence of the medulla which gives kemp its peculiar characteristics as distinguished from wool. Around the core, however, is a clear marginal cortex with a superficial serrated cuticle, just as in wool. The blackness of the core seen by transmitted light is due to refraction of the light by the minute inclusions of air within the interstices, and the silvery whiteness on a dark background to reflection of the light from the surface of the inclusions.

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* A more detailed account appears in Duerden and Ritchie, "Kemp Fibres in the Merino Sheep," Science Bulletin No. 34, Dept. Agric., Union of South Africa, 1924.

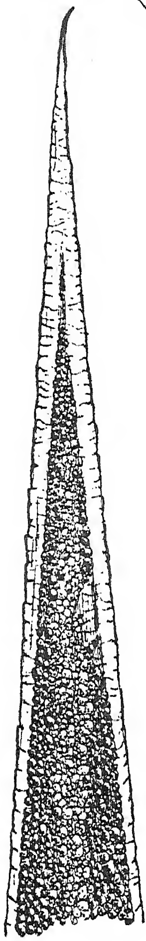


Fig. 3.

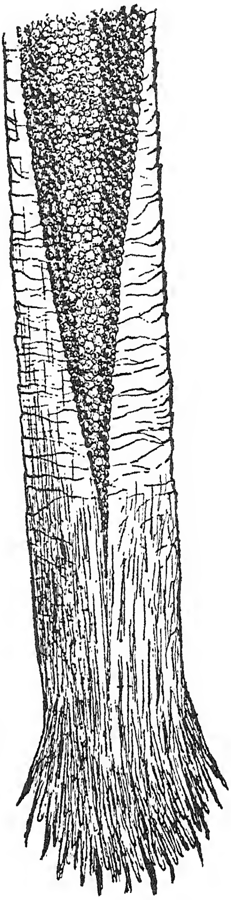
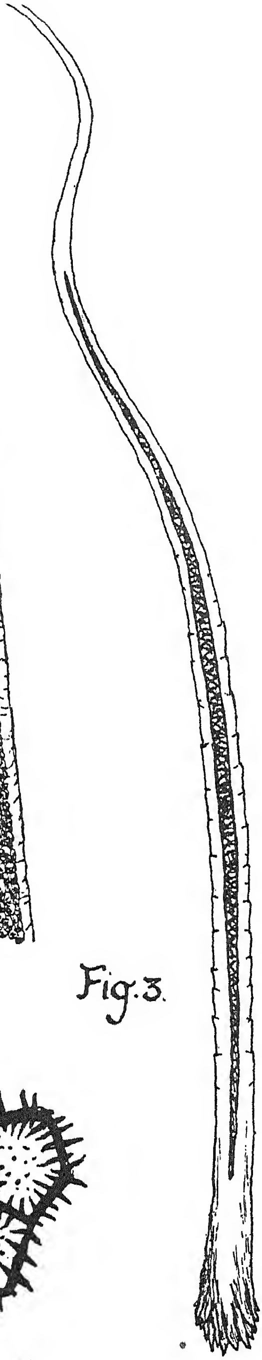
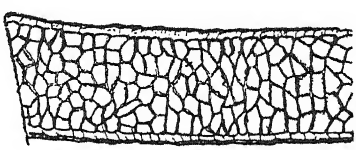


Fig. 2.





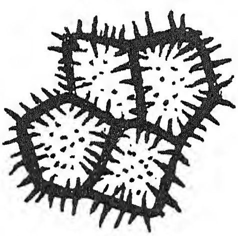


Fig. 5.

Fig. 1.

Fig. 4.

PART II., PLATE I.

FIG. 1—Kemp fibre from merino lamb, showing medulla.
,, 2—Root of kemp fibre, magnified, showing air inclusions in medulla.
,, 3—Tip of kemp fibre, magnified, showing air inclusions.
4—Medulla of kemp fibre with air removed.

Air in Kemp

All kemp fibres contain the central core of air within the minute hollow spaces in the medulla, and this gives them their peculiar dull whiteness when seen in contrast with wool fibres which are translucent. The air can be removed by placing the fibres for a short time in strong alcohol, and the fibres are then clear in transmitted light and no longer silvery by reflected light. In addition, the medulla is seen to possess a structure altogether different from the rest of the fibre, the cells of which it is composed being cubical and hollow, with thickened spinous walls (Figs. 4 and 5). As the alcohol evaporates air again enters the medullary spaces, and the black opacity and silvery whiteness are restored.

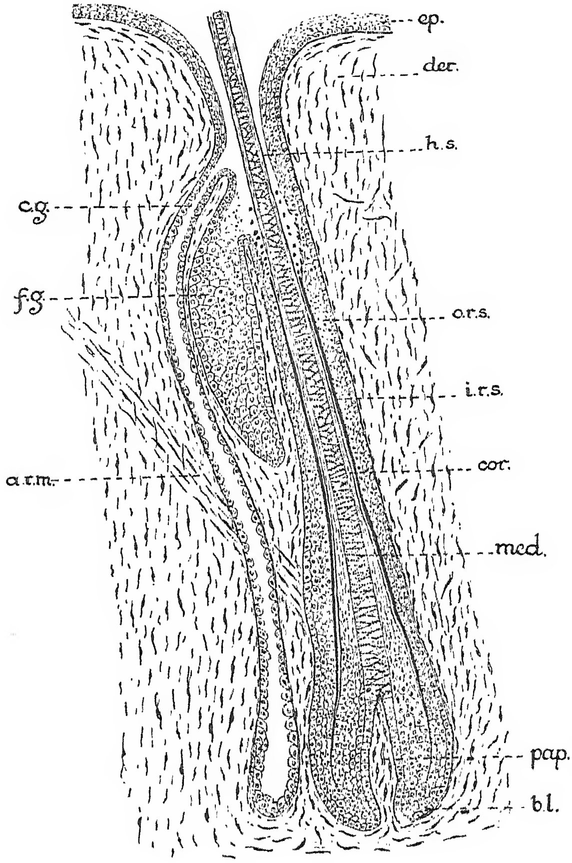
In the early development of a kemp fibre the medulla is found to arise as a special group of cells in the middle of the shaft, derived from the basal layer of the epidermis (Fig. 6). In the case of the cuticle and cortex keratinisation is complete, and the cells become solid, while in the medulla the cell walls only are thickened with minute spinous projections, the cavity remaining in each cell becoming full of air as the cytoplasm disappears. Wool fibres on the other hand are constituted entirely of solid, fusiform, cortical cells, covered with a serrated cuticle, the hollow medullary cells and air inclusions being absent. Wool allows light to pass through as well as to be reflected from its surface, whereas kemp is opaque at the core and reflects white light only. The fusiform cells of the cortex confer a certain degree of elasticity upon the wool fibre, while the medullary cells of kemp are non-elastic. Further, under ordinary conditions, where the merino is shorn, wool fibres grow continuously year by year without ever being shed; but kemp fibres have only a limited growth and, being shed from time to time, may often be found loose and entangled in the fleece.

It must be understood there are all stages in the formation of a medulla, and consequently all degrees of kempiness. Some fibres have only a very fine core with very few air inclusions; the latter may be even detached from one another, showing what is known as a "broken medulla." In general it will be found that the coarser is the fibre, the thicker is the medulla and the denser the air inclusions. For the sake of uniformity in terminology, it is suggested that any fibre containing air should be classed as kemp, or at any rate as kempy. The term would then include such coarse fibres as are known as dog-hair and gare, and even some of the stronger English wools where considerable air is present in the medulla. No sharp definition can be given of hair as contrasted with kemp or wool, but the fibres are usually coarser and medullated like kemp, and unlike wool.

Dyeing of Kemp

The view is generally held that kemp fibres do not dye, and on this account alone it is very objectionable among wool, since it interferes with the uniformity of colour of the finished product. Experiments prove, however, that the various dyes penetrate kemp just as readily as they do wool. This can be easily seen when the medullary air is removed; the cuticular, cortical, and medullary cells are then coloured alike, all being formed of the same chemical substance, keratin. When air inclusions are present, however, the colour of the dye is not transmitted, since the fibres are rendered opaque by the air. It is not that the fibres do not take the dye, but the physical conditions induced by the presence of fine inclusions of air prevent the colour showing to perfection.

Manifestly one of the great objections of the manufacturer to kemp, and to all fibres containing air inclusions, would be overcome if at some stage during the process of dyeing the air could be permanently removed. This might be done either by exhaustion or by solution in some reagent



PART II., PLATE II.

FIG. 6—Developing kemp fibre showing origin of medulla from basal layer of hair germ.

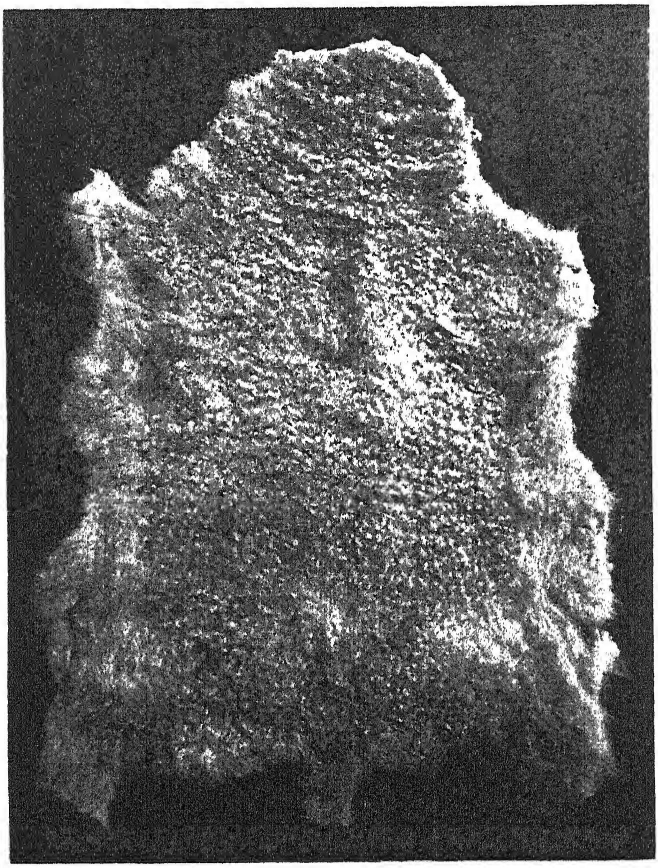
A.R.M., arrector pili muscle.
B.L., basal layer.
C.G., coil gland.
COR, cortex of fibre.
DER, dermis of skin.
EP, epidermis of skin.
F.G., fat gland.
H.S., hair shaft.
I.R.S., inner root sheath.
MED, medulla.
O.R.S., outer root sheath.
PAP, papilla.

such as alcohol. It is plain that where the highest perfection of colour is desired, the fibres must on no account contain medullary air.

Origin of Kemp

A true understanding of the origin of kemp can be gained only from a comparison of the outer covering of the merino with that of other breeds of sheep and goats, and with mammals generally. In their natural state nearly all mammals have two coats of hair—an outer coat of long, coarse fibres, and an under one of short, soft, fine fibres, the latter constituting the true fur in fur-bearing animals. The outer coat serves more for protection, the under one for warmth, and both tend to vary with the season.

In the merino, therefore, we have to consider the possible occurrence of these two coats. All considerations of its ancestry go to prove that the merino had originally an outer coat of coarse, kempy fibres, and an under one of fine fibres. In the best strains the kempy coat has now largely disappeared from the adult as a result of long selective breeding, while the woolly coat has been almost exclusively developed, and to-day forms



PART II., PLATE III.

FIG. 7—Skin of new-born merino lamb. The outer coat of long kempy fibres is clearly shown at the sides, and the under coat of curly tufts of wool over the general surface.

practically the only covering of the sheep. When kempy fibres occur they may be looked upon as the retention of an ancestral hereditary character which has not yet been bred out. Under farming conditions the fine fibres have increased greatly in number and crimpiness, and instead of being shed at intervals now grow continuously for the lifetime of the sheep, and exceed the kempy fibres in length.

That the ancestors of the merino had two coats—a longer coarse and a shorter fine—receives striking confirmation from the covering of the new-born lamb (Fig. 7). Here the whole of the body, the back and sides, as well as the head, limbs, and tail, is provided with long, straight, kempy hairs,

each with a medulla and air inclusions, while below is a denser covering of fine solid fibres, arranged in short, curly tufts. Different lambs vary much in the number of the outer fibres, and they may be almost absent from some parts of the body and plentiful in others. The coarse hairs are shed very early from the time of birth onwards, and the covering then consists of the under coat only, the woolly fleece. Sections through the skin of the new-born lamb show all stages in the shedding of the coarse fibres.* The well-known principle embodied in the biological Law of Recapitulation implies that in the course of their development animals tend to pass through the stages which repeat the characteristics of their ancestors. Accepting this, we may with every justification regard the two coats of the lamb as an ancestral stage in the evolution of the merino. As a result of selection under domestication, the kempy coat now largely disappears after birth, to reappear, however, with each succeeding generation of lambs. Remnants tend to persist longest on the extremities—head, legs, and tail—but complete elimination should be possible by continued selection in breeding.

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* Duerden and Ritchie, "Development of the Merino Wool Fibre," S. A. Journ. Science, Vol. XXI., Nov. 1924.

PART III.—KEMP IN THE FLEECE OF THE WELSH MOUNTAIN SHEEP

By J. A. Fraser Roberts, M.A., B.Sc.

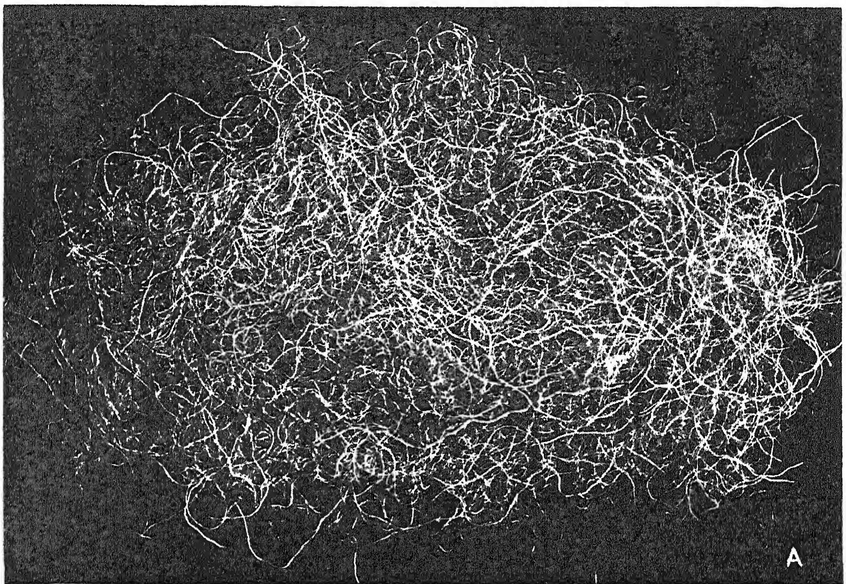
(Animal Breeding Research Department, University of Edinburgh)

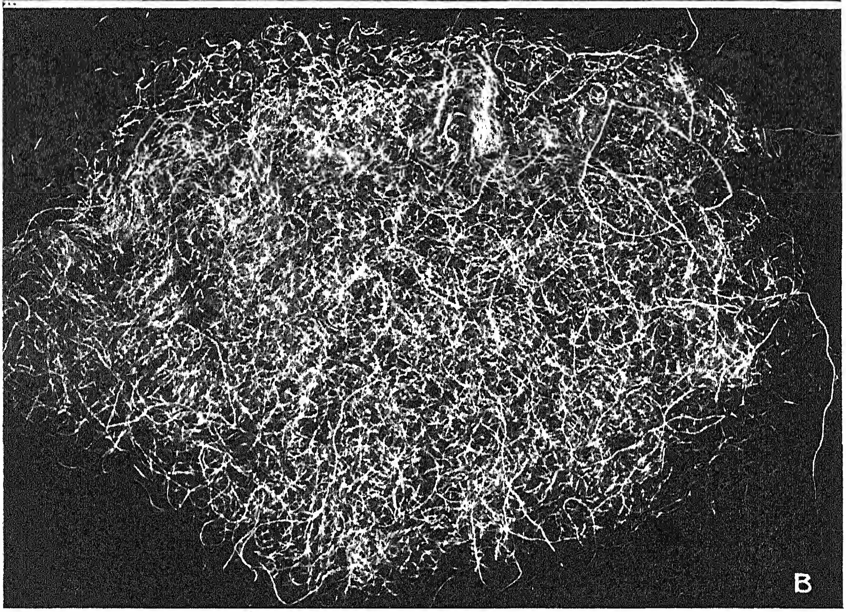
INTRODUCTION

The following account of kemp in the fleece of the Welsh mountain sheep has been prepared from some of the results of work in connection with a scheme for the investigation of the possibilities of wool improvement in that breed put forward by the University College of North Wales, Bangor, and carried out in conjunction with the Animal Breeding Research Department, University of Edinburgh.

The scheme aims at improvement by selection within the breed, and it will readily be appreciated that this fact has led to the problems connected with the occurrence of kemp being approached from a particular angle—and an essentially practical one. There is extreme variation in Welsh fleeces, and the first consideration is to discover and measure those differences which make a fleece a good one or a bad one, and so attempt to increase the number of the former class at the expense of the latter. For this purpose, those characters that are common to all Welsh sheep—good and bad alike—for example, the nature of the covering of short hair on the face and legs, are only of incidental importance at present. It was urgently necessary to find a definition for kemp that would be sound economically and at the same time rest upon real biological distinctions between kemp and other fibres. It was no less urgently necessary to develop a method for the quantitative estimation of kemp, so that the great individual variations in this respect could be expressed in actual figures. Having once reached this point, it becomes possible to consider the extremely important subject of the occurrence of kemp, together with all those other technical, scientific, and agricultural factors that are involved in such a scheme. It will be found that little stress has been laid on microscopic analysis; the work is less a study of kemp as such than an elaboration of methods for a particular purpose, and it was found that this object could best be attained in other ways. It is hoped that the methods developed for the study of Welsh wool will be of use in the study of the fleeces of other breeds. These methods are being utilised in this way in this Department.

The laboratory work in connection with this research has been carried out at the Animal Breeding Research Department, University of Edinburgh, and I wish, as always, to express my gratitude to my chief, Dr. F. A. E. Crew. Material has been obtained at the College Farm of the University College of North Wales, the pedigree and mountain flocks of the College being freely utilised. Professor R. G. White, in addition to making the work possible, has devoted to it a great deal of personal attention, and it would be impossible to over-emphasise the value of his co-operation. My thanks are also due to Mr. R. N. Jones for his help in the practical grading of the sheep, and to Mr. James Briggs, of Elland, for assistance on the technical side. During the course of the work close contact has been maintained with the staff of the British Research Association for the Woollen and Worsted Industries; their assistance has been of the greatest value.





PART III., PLATE I.

A—Sample of Welsh wool (rump), containing 16·0% kemp by weight. $\times 1\frac{1}{2}$.

B—Sample of Welsh wool (shoulder), containing 3·9% kemp by weight. $\times 1\frac{1}{2}$.

The Macroscopic* Characteristics of Kemp

If a sample of Welsh wool is examined it is usually apparent that there are present fibres having certain peculiar characteristics that mark them off from ordinary wool fibres. They are called kemp, and it is the purpose of the first part of this paper to consider these fibres from various points of view and so arrive at a satisfactory definition. Several salient points stand out on naked eye inspection. Plates I. and II. show four samples of wool containing varying amounts of kemp. Plate III. shows a range of kemps slightly magnified. Plate VII. A is a very kempy sample, while VII. B shows the same sample separated into kemp and non-kempy fibres. Reference to these photographs will make the description clear.

(1) *Shortness*—Kemps are short in comparison with other fibres, varying from $\frac{1}{4}$ in. to 2 in. or a little more in length; those approaching the latter limit are rare.

(2) *Coarseness*—On the average they are extremely coarse.

(3) *Waviness*—The great majority exhibit a characteristic waviness which is well shown in the photographs.

(4) *Whiteness*—Kemp fibres stand out owing to a dead-white opaqueness which contrasts sharply with the more transparent appearance of other fibres. This is due to their relatively large medulla, the meshes of which contain air, hence light is refracted.

(5) *"Breaks"*—Certain kemp fibres exhibit at points along their length more transparent flattened deformed portions. In addition, there are sharp bends at different points along the fibre.

(6) *Flattening*—It is apparent that kemps are usually not nearly circular in section.

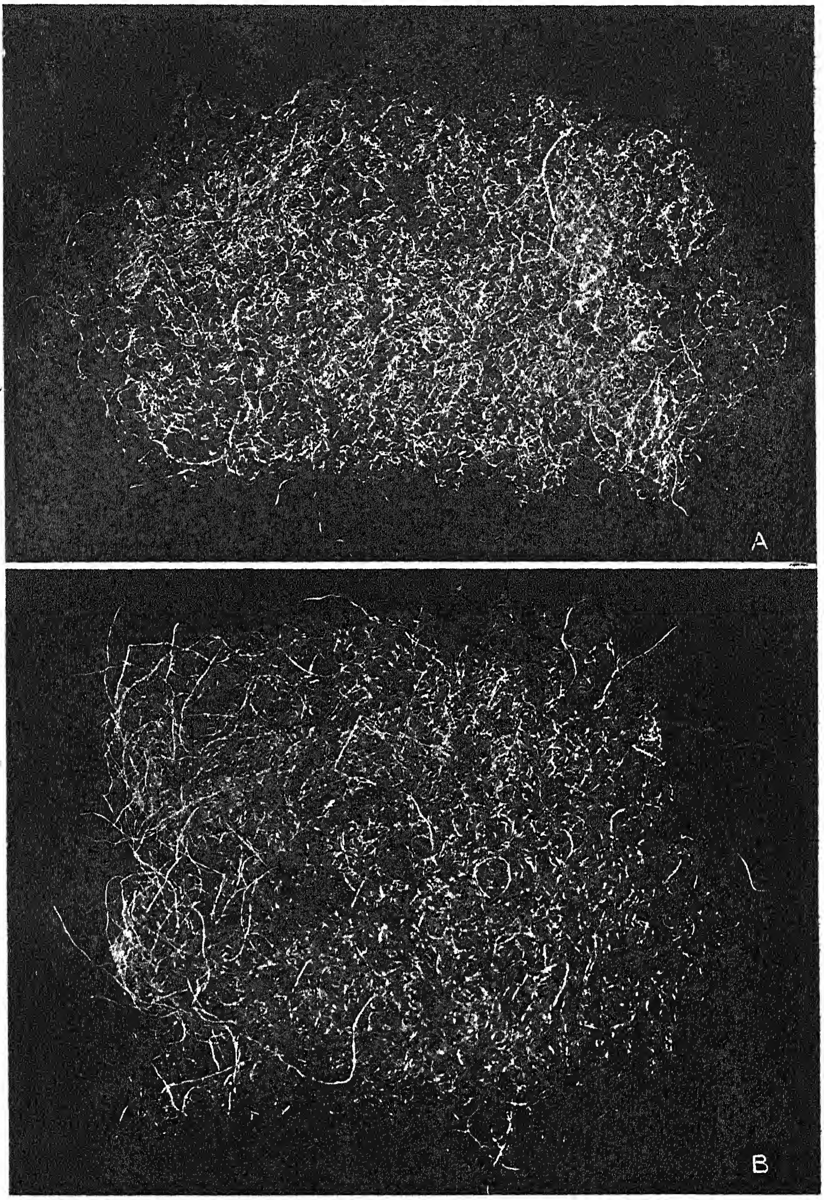
(7) *Brittleness*—Their tensile strength is very low.

(8) *Pigmentation*—In Welsh fleeces, "red kemp" sometimes occurs. These fibres are kemp fibres and it is very characteristic of kemp that it should sometimes be pigmented if there is a tendency in this direction, while the other fibres are not coloured or at least only occasionally show lightly pigmented tips.

(9) *The Nature of the Extremities of Kemp Fibres*—None of the above points are absolutely diagnostic of kemp. They are certainly true in most cases, but individual fibres may be found where one or more do not hold. Some of the points are relative and other fibres may occasionally approach kemp in regard to some of them. What the writer believes to be the most important characteristic of kemp from the point of view of definition remains to be discussed. Almost every kemp fibre will be found to possess a whip-lash tip, and towards the proximal† end there is a thinning off which terminates in a little bulb which indicates that the fibre has been shed from its follicle. In the case of those kemp fibres (relatively few in number) that do not show this characteristic it is readily seen either that the fibre has not finished its growth and has been cut off in the middle, or else that the tip has been broken off, but this is rare. This characteristic involves the mode of growth of kemp fibres and is discussed more fully in the next section.

In some samples fibres are occasionally found which appear to possess portions having some of the characteristics of kemp, the remainder of the fibre being definitely non-kempy. Such fibres are not common and their kempy portions hardly ever resemble typical kemps. It is rather the thoroughly a-typical finer kemps that they do resemble. For many reasons

* i.e. Naked eye. † i.e. Nearest the body.



PART III., PLATE II.

A—Sample of Welsh wool (shoulder), containing 1·8% kemp by weight. $\times 1\frac{1}{2}$.
B—Sample of Welsh wool (rump), containing 8·0% kemp by weight. $\times 1\frac{1}{2}$.

they cannot be admitted to be true kemp fibres. They are referred to below in connection with the question of definition.

The Growth of Kemp

If the coat of a Welsh sheep is examined, say, in December, it will be found that the kemp fibres are either lying free in the fleece or else are very loosely attached to the skin. All will show both root and tip. In the case of the other fibres composing the fleece, wool or hair as the case may be, the vast majority will show neither of these features. Kemp is therefore annual in its growth and the examination of fleeces at different times of the year shows that the growth period is roughly from March to September or October. Fibres other than kemp grow continuously, merely becoming thinner at the time of the "rise" in the wool. Of course, fibres other than kemp are occasionally shed and new growth does occur, but such cases are relatively infrequent and represent a very different phenomenon to the regular annual growth of kemp. Here there is to be found a real fundamental distinction between kemp and all other fibres.

The mode of growth of kemp is well illustrated by Plate IV. A. In this case the kemp is red and so shows up clearly against the white wool. It will be seen that towards the tip of the staple lies the previous year's growth. There is then an interval and then the new year's growth which was coming up when the sheep was shorn. Plate IV. B shows a sample of Suffolk wool containing dark fibres which are also of a kempy nature, and in this case, too, the same phenomenon is seen.

It should be noted as a very important distinction that the shedding of kemp and the appearance of the new crop in no way corresponds in time to the "rise" in the wool, a time when some other fibres instead of merely becoming thinner are occasionally shed and replaced by new ones. By the time the "rise" occurs the growth of the kemp is already well established.

The Microscopic Characteristics of Kemp

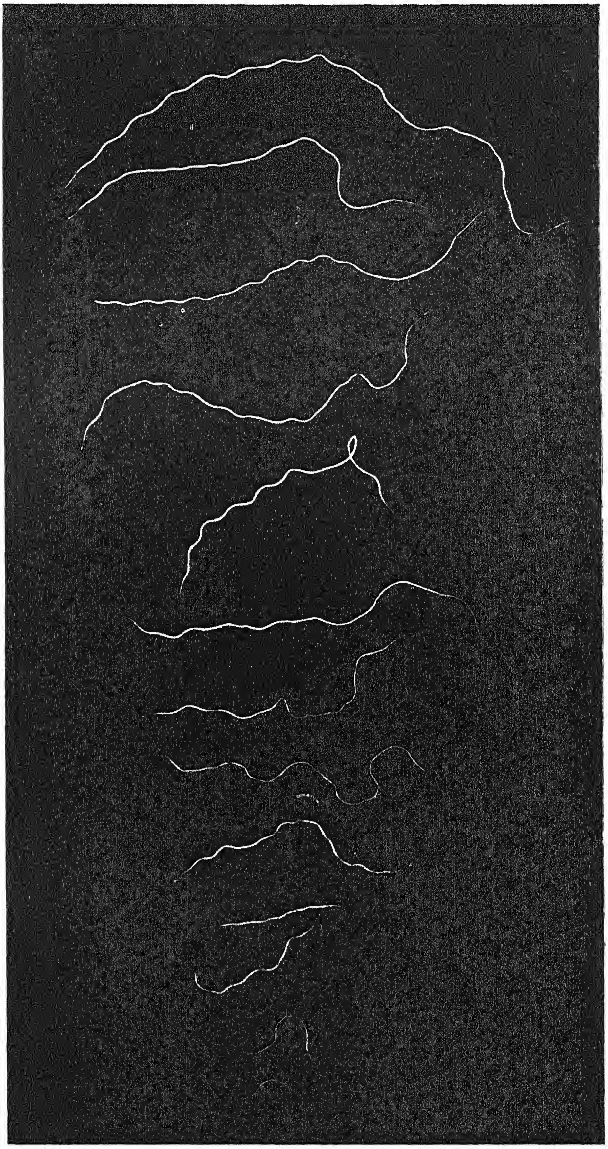
Plate V., Figs. 3–6, show sections of kemp fibres. Fig. 7 is a low-power picture of the proximal end of a kemp fibre. Figs. 1–2 are sections of hair from the Welsh fleece for comparison. A histological study shows that kemp fibres, like other mammalian hairs, are made up of three layers—cuticle, cortex, and medulla. The cuticle possesses some special features as compared with that of ordinary hair fibres from the Welsh fleece, in that the scales are more compressed in a vertical direction; this gives the fibres a more serrated edge in section. The cortex for the greater part of its length is relatively thin, the greater part of the bulk being taken up by a reticulate medulla. The medulla of kemp fibres is rather less regular than that of hair fibres, being less evenly rounded and appearing more compressed.

A special feature of kemp is the extreme irregularity of shape at various points. This is well shown by the photographs. Fig. 4 shows the medulla compressed almost into a state of solidity.

The Origin of Kemp

Most mammals possess two coats—an outer coat of protective hair, and an inner warmth-retaining coat of fine hair; this is also true in the case of many wild and primitive varieties of sheep which undoubtedly resemble the ancestors of our modern breeds. There are several reasons for holding that kemp in the modern fleece is a remnant of the primitive outer coat—

(1) There is great similarity between kemp fibres and primitive hair; Plate VI., Fig. A, shows a sample of the coat of *Ovis dalli*, the American



PART III., PLATE III.

Various types of kemp fibres from Welsh fleeces. $\times 1\frac{1}{2}$. Note extremities.

Bighorn, and Fig. B on the same plate is a photograph of a very kempy piece of Welsh wool taken from the hind leg just above the hock. The similarity is very marked.

(2) Certain sheep may be found the coats of which represent a sort of intermediate condition between the two coats of the primitive sheep and a kempy fleece. It is stated, for example, that Shetland sheep can be found in which there are practically two coats, and yet this condition would be only a little more extreme than, say, a very kempy Welsh fleece.

(3) In many primitive varieties of sheep the outer coat is pigmented and the inner coat is white except that some of the fine wool fibres have slightly pigmented tips. Exactly the same situation is seen in Plate IV., Fig. A, a sample of Welsh wool showing a lot of red kemp. Where red kemp occurs it is usual to find a few wool fibres with lightly pigmented tips. The same phenomenon is even better seen in the Suffolk; for this description and for the photograph on Plate IV., Fig. B, I am indebted to my colleague Mr. J. E. Nichols. In the Suffolk fleece, when dark fibres occur, the pigmentation is found in short, very dark, definitely kempy fibres, and in addition many of the wool fibres have lightly pigmented tips.

(4) The writer has not had much opportunity of observing the mode of growth of the coat of primitive sheep. In this Department, however, there is at present a black-headed Persian ewe, a gift from the South African Government. This sheep possesses a coat which is strictly analogous to that of wild sheep. It consists of a very coarse outer coat and an extremely fine inner coat. Many of the fibres composing the outer coat were (end of October 1925) quite loose and came away readily, showing the proximal thinning and the little bulb so typical of Welsh kemp, and that was the very time of the year that the precisely similar process of the shedding of kemp was going on in the fleeces of Welsh sheep.

The Definition of Kemp

A consideration of the above facts leads naturally to a definition of kemp. An adequate definition should satisfy the following conditions—

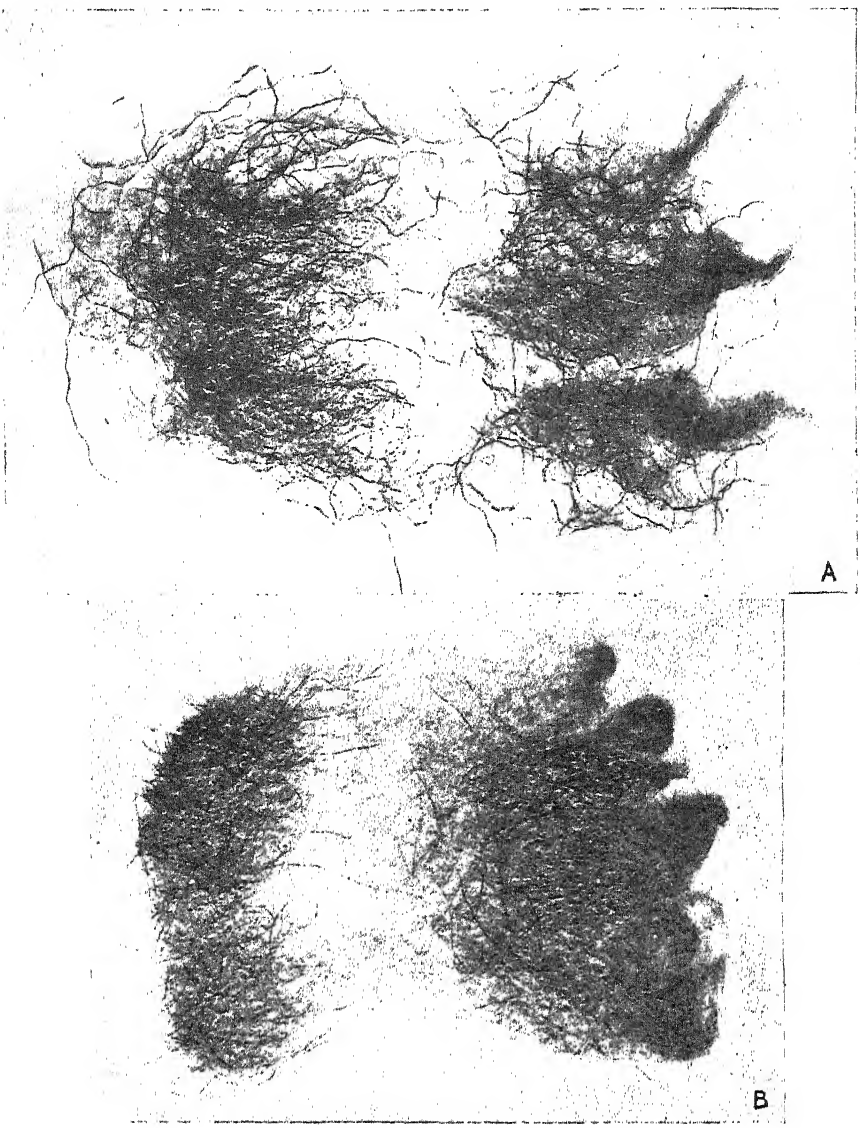
(1) The distinction between kemp and other fibres should be both sharp and qualitative.

(2) The distinction, if it is to be used practically, should permit rapid and accurate naked-eye separation into the two groups—kempy and non-kempy.

(3) It is desirable that the separation into the two groups should be one that would correspond to the technical opinion of what constitutes kemp.

(4) It would be highly satisfactory and an indication of profitable biological discovery in the future if the definition were to represent a real morphological distinction.

Above all, then, kemp is a fibre that is annual in its growth. This distinction satisfies conditions 1, 2, and 4, and it will be shown later how well it also satisfies condition 3. In an attempt completely to separate the kemp fibres from Welsh samples, this characteristic, together with a recognition of those qualities mentioned under the heading "macroscopic characteristics,"



PART III., PLATE IV.

A—Sample of Welsh wool containing red kemp to illustrate mode of growth of kemp fibres. Natural size.

B—Sample of Suffolk wool containing black kemp fibres to illustrate mode of growth. Natural size.

are amply sufficient. In a sample taken at shearing time nearly all the kemps will have root and tip and present no difficulty. At the bottom of the staple will be found a certain number of cut kemps, and these can in almost every case be recognised by attention to the points mentioned.

In some samples the anomalous fibres already described will be found; they appear to be wool fibres for the greater part of their length, but exhibit portions (usually tip) of a kemp-like nature. It is impossible to admit them as kemps, although to the manufacturer they would be equally objectionable. They can be neglected for the purpose of definition and estimation for the following reasons—

(1) The number found is always extremely small compared with that of the regular kemp fibres. In many samples none occur.
(2) Although they exhibit "kempy" portions these portions are hardly ever quite the same as typical kemp; it is rather the finer a-typical kemps that they resemble.

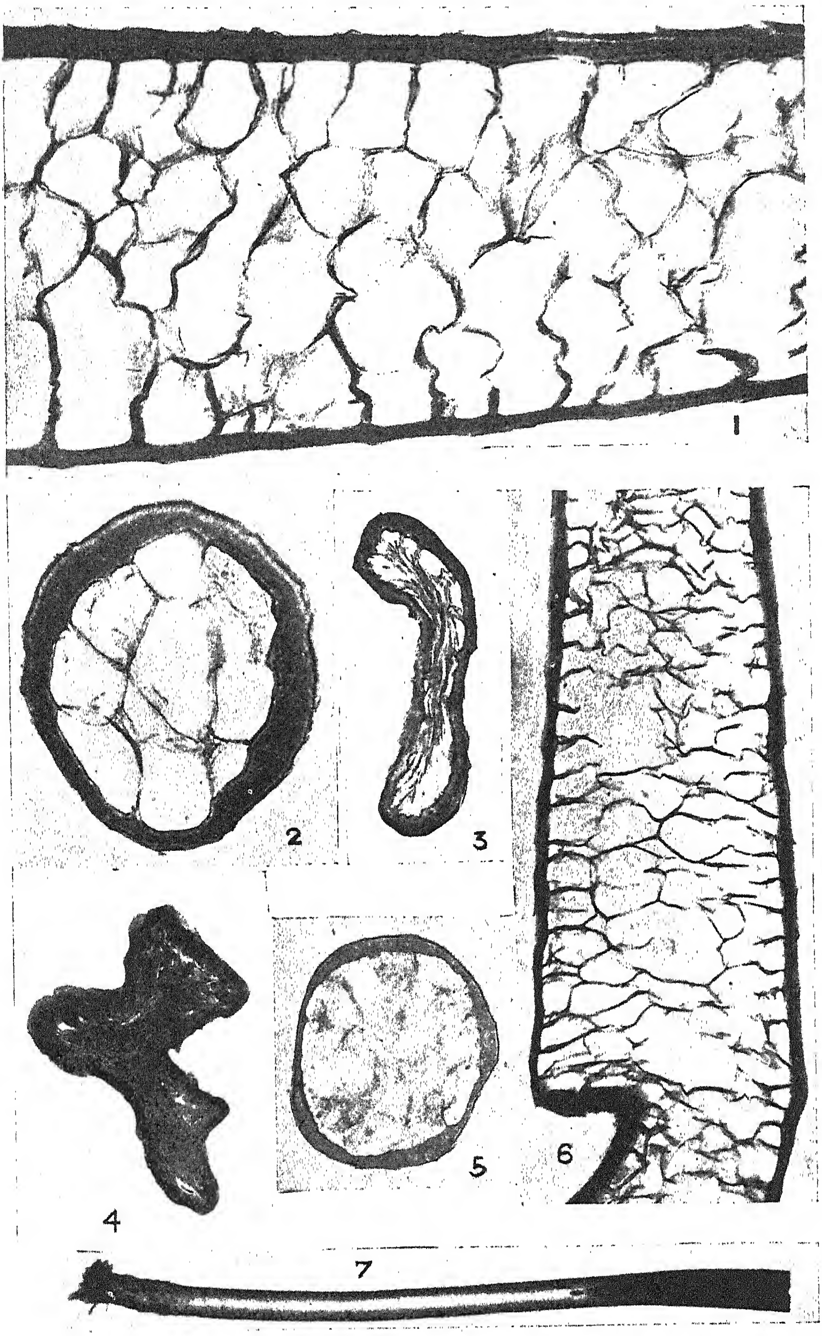
It is possible that some observers would call "kempy" any fibre which showed by its coarseness and opaqueness that it had an air-filled medulla. Hair fibres and many quite fine wool fibres have an air-filled medulla at least for part of their length, but such fibres shade off without definite discontinuity anywhere from coarse hair to fine wool, so that such an attitude would destroy the most useful distinction that can be made out in the fleece. There are many important qualities in the fleece, and fineness of fibre is not the least of them, but though an important subject it is quite a different one. The problem of kemp involves the elimination of a totally distinct coat of the sheep and is therefore a simpler one in every way.

The hypothesis as to the origin of kemp is well supported but is, of course, hypothesis and not fact; nevertheless it is an encouraging speculation in that it emphasises the fundamental nature of the distinction which has been reached independently by direct observation.

The Quantitative Estimation of Kemp

The preceding part of this paper leads to an examination of the question of the estimation of kemp by the actual separation of fibres in samples. Methods which involve the counting of fibres are not very satisfactory; they are too laborious and present several difficulties, e.g. cut and broken fibres. The method which has been found to give by far the best results is the determination of the weight of kemp in a sample. From 0·2 to 0·3 grams of wool are carefully separated off so as to get a complete staple and washed in ether. The sample is then dissected out bit by bit on a board covered with black velvet, the kemps being separated from the non-kemp fibres. The two portions are then weighed and the percentage kemp by weight in the sample determined. After considerable experience of this method the writer finds that there is no difficulty about the separation and that a very accurate determination can be made.

The chief difficulty is the selection of samples which shall give a fair estimate of the kempiness of the fleece as a whole. Not sufficient work has yet been carried out for an authoritative and final opinion to be pronounced on the subject. It is a matter of the careful selection and analysis of samples from various regions in the case of a large number of fleeces, and a determination of the regularity of the distribution of fibres over small areas; this work is now in progress.



PART III., PLATE V.

FIGS 1 and 2—Longitudinal and transverse sections of hair from Welsh fleece (for comparison). ×425.

,, 3, 4, 5, and 6—Longitudinal and transverse sections of kemp fibres. Figs 3 and 4. ×250. Figs. 5 and 6. ×220.

FIG. 7—Proximal end of kemp fibre. ×55.

Although the question of the precise method of sampling has yet to be standardised, some indication of the results obtained may be of interest. Most of the analyses so far carried out have been on samples taken from the point of the shoulder and the point of the rump in the case of each sheep (sometimes the britch instead of the point of the rump). These two figures appear to give a very fair indication of the kempiness of the fleece as a whole. The point of the rump is about the worst place in the fleece apart from the trimmings, and if kemp is low in amount there the fleece may safely be pronounced relatively free from kemp. The percentage at the shoulder is of importance because it gives an indication of the extent to which the kemp is spread throughout the whole fleece; 2% or 3% of kemp at the shoulder is a serious matter and is a certain indication of a fleece that is thoroughly kempy all over.

Plates I. and II. show four samples of Welsh wool—two from the shoulder and two from the rump—containing varying amounts of kemp. Plate VII. shows a piece of the same sample as Plate I. A, and below the same sample separated out. In this case the proportion of kemp was 16%. Welsh fleeces can be found with less than 0·1% both at shoulder and rump; in the case of really kempy fleeces these figures may go up to 7% and 20–25% respectively. A very fair estimate of the kempiness of the fleeces is therefore possible on the basis of these figures. In the next section some typical analyses are given and compared with the manufacturer's grading.

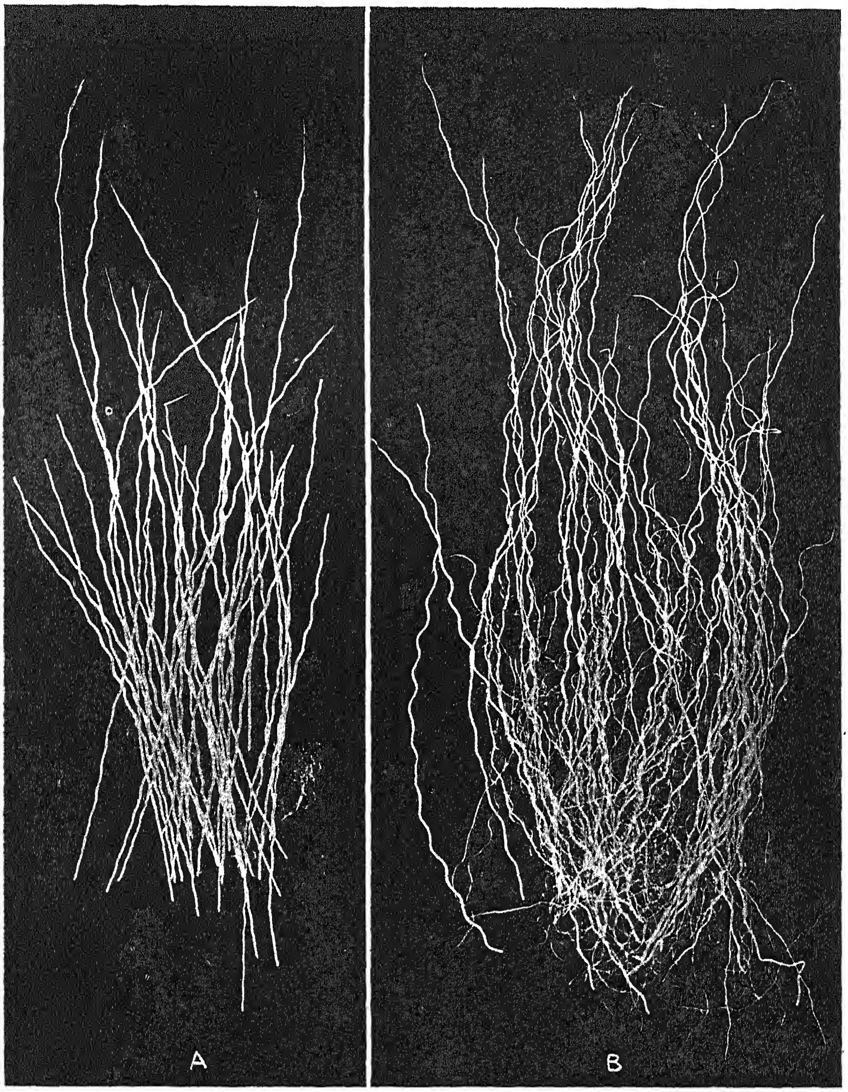
The quantitative estimation of fibres of different classes by weight can be applied to the separation of fibres other than kemp. Although in such cases the distinctions are not so clearly qualitative, it is possible by carefully deciding on standards and preparing a scale of fibres for reference to attain a high degree of accuracy. There is a personal factor in the selection of standards which does not arise in the case of kemp, but still the method is one of considerable usefulness and is being applied to the fleeces of other breeds in this Department.

Kemp in the Welsh Fleece from the Point of View of the Manufacturer

In the opinion of the manufacturer the outstanding defect of Welsh wool is the presence of kemps. The best Welsh fleeces go into the Down grades, being practically as good as Shropshire. Every improvement therefore would simply carry Welsh wool higher in the class it is already in.

It is a matter of great importance to ascertain whether the manufacturer's opinion of what constitutes kemp coincides with the definition that has been reached in the laboratory. Several samples were taken and divided into two portions. From one portion the kemp was removed as in analysis, the other being left untreated. These samples were then submitted for technical examination, the most important point being whether in the opinion of the expert those portions from which the kemp had been removed were really free from kemp in the trade's sense. All the samples were pronounced to be free as far as handling and naked-eye examination went, except in one case where the report stated that one kemp fibre seemed to have been overlooked; this was an anomalous fibre. This close correspondence between the technical definition of what constitutes kemp and that reached on biological grounds is extremely satisfactory.

There are two main points in the grading of Welsh fleece, "kemp" and "quality," and kemp appears to exercise the greatest influence on the value



PART III., PLATE VI.

A—Tuft of coat of *Ovis dalli* (American Bighorn). × 1½.
B—Tuft of coat of very kempy Welsh sheep taken just above hock. × 1½.

of the fleeces. The following table shows the results of the analyses of some Welsh fleeces and the manufacturer's grading chosen quite at random—

Sheep	% Kemp at Shoulder	% Kemp at Rump	Manufacturer's Grading	Manufacturer's Remarks
S 4	0·1	0·5	1	Down character, fine quality, little kemp.
S 59	< 0·1	1·5	1	,, ,, ,, ,,
S 62	< 0·1	3·2	1	,, ,, ,, ,,
S 48	0·5	4·7	2	
S 13	1·2	5·3	2	
S 19	0·6	1·3	3	
S 18	1·5	7·3	3	Long staple.
S 52	2·2	15·7	4	Lowest in quality and most kemp.

It will be seen that on the whole there is good correspondence between the percentages of kemp and the manufacturer's grading. S 18 and S 19, where this does not appear to hold so strictly, were undoubtedly coarse apart from kemp. Red kemp is particularly objectionable; it is dealt with in a separate section.

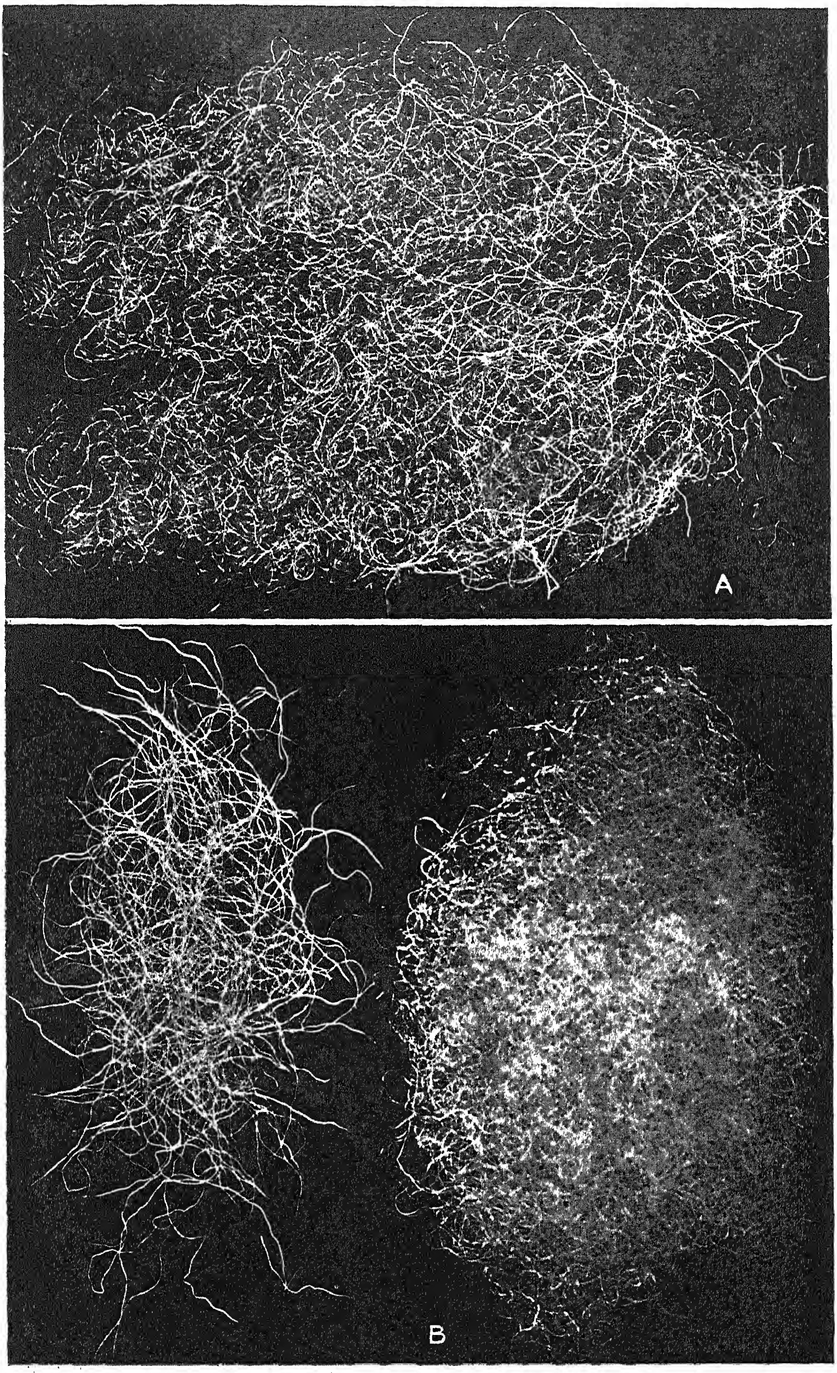
Kemp in the Welsh Fleece from the Point of View of the Sheepbreeder

The consideration of those factors which have a special importance to the sheepbreeder represents a large and important section of the whole scheme of wool improvement. Any detailed discussion of the points which have to be considered would be out of place in the present paper, but as the possibility of any improvement at all depends upon its reasonableness from a practical point of view, and as again the question of kemp is the most important one, a brief summary will be given.

To the breeder of mountain sheep hardiness is a paramount consideration, and the fleece is regarded first of all as an efficient protection or otherwise to the sheep at all stages in its life. Most breeders of Welsh sheep hold that the presence of kemp is associated in some way with hardiness and herein lies the great obstacle in the way of improvement. In order to reduce the breeder's requirements to definite standards, as regards the adult fleece, a scale of points was constructed by Professor White and Mr. R. N. Jones as follows—

(1) *Length*—Optimum length, 10; fleeces that are too short, 9, 8, &c.; those which are too long, 11, 12, &c. The usual fault is that fleeces are too long.
(2) *Density*—This is a point of great importance. A dense weather-resisting coat is highly desirable for mountain conditions. Maximum, 10.
(3) *Absence of Lockiness*—An objectionable feature is the tendency of some fleeces to fall into "locks," thus allowing rain to penetrate. Complete absence, 10.
(4) *Fineness of Fibre*—Greatest fineness, 10.
(5) *Absence of Kemp*—Almost complete absence, 10 (this point was determined arbitrarily by inspection, and the optimum value is, of course, the whole problem).

It was found from the grading of a very large number of sheep that the proportion of kemp was not correlated with any other point. That is, a long fleece may be kempy or not; a short one may be equally kempy or equally free; and so on. Therefore it is possible to conclude that the elimination of kemp would not injure any quality that the breeder values in the adult fleece. On the other hand, it is interesting to note that shortness, density, absence of lockiness, and fineness are pretty closely correlated



PART III., PLATE VII.

A—Sample of Welsh wool (rump). $\times 1\frac{1}{2}$.

B—Same example separated into kemps and non-kemp fibres (16% kemp). $\times 1\frac{1}{2}$.

together and that here the interests of the manufacturer who wants quality and those of the breeder are practically the same.

Another point of importance has to be considered, and in this case the position is not so simple. The coat of the lamb at birth should be thick and weather resisting; it was found that three types of birth coats occurred Welsh sheep—

I.—Thick hairy coat all over.

II.—Fine curling wool on shoulders and fore part of body only.

III.—Fine curling wool all over.

Type III. and the finer varieties of Type II. are definitely unsuitable for mountain conditions. It has also been found that unfortunately there is an association between a good covering at birth and a kempy adult coat, as is shown by the following figures taken from the grading of 180 sheep—

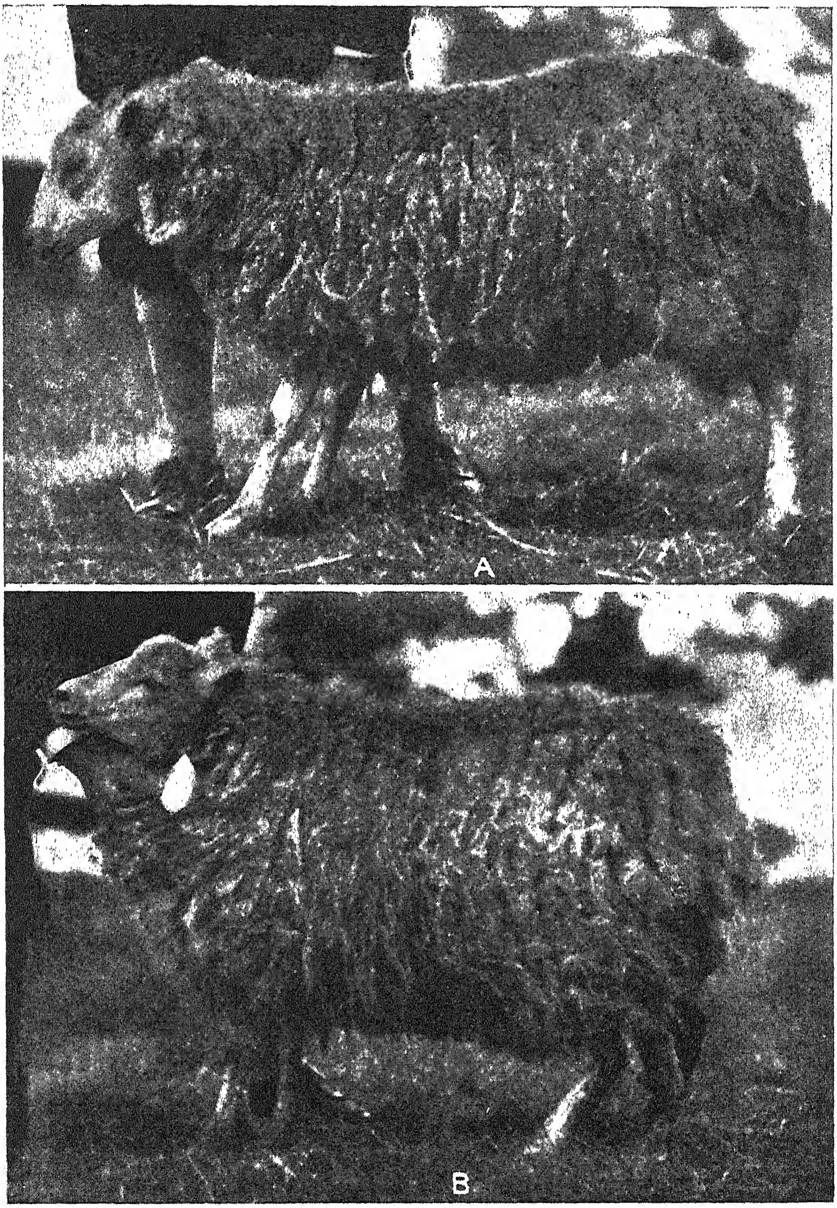
Number of Sheep	Coat at Birth	Breeder's Estimate of points for absence of Kemp in Adult Fleece—Average
52	I.	$6 \cdot 5 \pm 0 \cdot 12$
97	I.	$8 \cdot 1 \pm 0 \cdot 07$
30	III.	$9 \cdot 5 \pm 0 \cdot 09$

Some breeders talk, not of a kemp-free ram leaving stock on the mountain deficient in hardiness, but of such an animal giving rise to progeny with poor birth-coats, and it is probably just this point that is responsible for the belief in a connection between kemp and hardiness. It is also certain that mere selection for fine-coated adults, regardless of anything else, is going to injure hardiness in just this way. However, the problem is not insoluble; the figures above are only an average. In 14 cases out of the 52 sheep of Type I. above, the estimate of kemp was 8–10, so that it is possible to get lambs with a thick coat at birth which are yet relatively free from kemp as adults. The key to the problem lies in the shedding of the lamb's coat. In some cases, such as the 14 mentioned, the birth-coat is shed and does not lead to a thick growth of kemp later. In other cases the birth-coat persists, resulting indirectly in a kempy fleece. Analogous conditions in other breeds make the problem yet more hopeful. For example, in certain merinos the lambs have a thick hairy birth-coat, which is more or less completely shed, leaving a fine adult coat. What the breeder has to aim at, therefore, is the retention of the thick birth-coat and at the same time selection for a lower proportion of kemp; it would be a mistake to secure freedom from kemp by sacrificing the birth-coat. Some breeders will, however, still believe that there is some other and quite obscure connection between kemp and hardiness, and this is a matter that can only be tested by actually observing under mountain conditions the success or otherwise of sheep which come up to specification. The question of the lamb's coat and its relations to kemp will, it is hoped, form the subject of another paper.

Further Considerations

It is hoped that the work outlined above will provide the basis for research in a number of directions. For example, it will be possible to observe the variations in the fleece from year to year, and the importance or otherwise of the effects of environment. It will also be possible to carry out genetical experiments in order to attempt to discover the mode of inheritance of the various characteristics that have been defined.

There are many gaps, but it is hoped that there are sufficient indications that these can be filled up by further work. Kemp determinations are



PART III., PLATE VIII.

A—Welsh sheep with practically ideal coat, kemp not weighable even at rump. Short, dense, and of good quality.

B—Welsh sheep from same flock with long, coarse, open kempy coat.

being carried out on a large number of samples from pedigree sheep that have been graded both by breeder and manufacturer, and in this way it will be possible to link up all these considerations yet more closely.

Red Kemp

Red kemp fibres are undoubtedly kempy in their characteristics but they are not so amenable to laboratory determination as ordinary kemps, because their distribution is not regular; they occur in patches. They are associated with the slightly tan face and legs and also with the tan patches in new-born lambs that are characteristic of Welsh sheep. It will be seen, however, as the work progresses how far, if a reduction of ordinary kemp is effected, the red kemp would tend to be automatically diminished also. It is probable that as much information regarding these fibres will be obtained during the course of work on ordinary kemp as would be secured by any *ad hoc* experiments that could be devised.

Summary

(1) Kemp in Welsh wool is described as regards its naked-eye characteristics, its mode of growth, and histological structure. A hypothesis is advanced as to its origin. This leads up to a definition of kemp.

(2) A method for the quantitative determination of kemp is described.

(3) The importance of kemp to the manufacturer is discussed and the correspondence between the biological definition that has been laid down and the technical opinion of what constitutes kemp is pointed out.

(4) The ways in which kemp affects the sheepbreeder in its possible relations to other qualities of the sheep are briefly discussed, and from this emerges a possible line of wool improvement. The special importance of the birth-coat and its relation to kemp in the adult fleece is also discussed.

(5) A brief reference is made to the occurrence of red kemp.

PART IV.—KEMP FIBRES IN FLEECES OF BRITISH BREEDS OF SHEEP

By Janet S. S. Blyth, Ph.D.

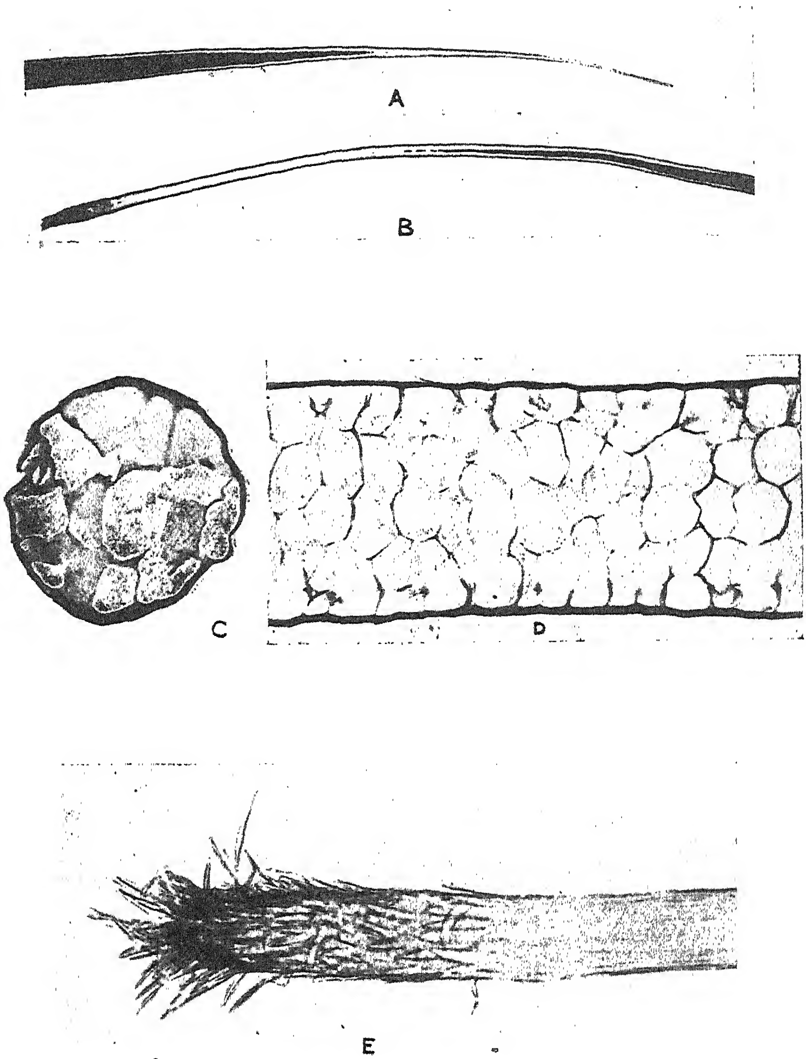
(Animal Breeding Research Department, University of Edinburgh)

The word "kemp" is so frequently used loosely to describe coarse fibres of any kind in the fleece of the sheep or the wool-bearing goats, that it is necessary to begin by making clear the more restricted sense in which it will be used in the present paper. "Kemp" will designate a fibre which is in all but the long-woolled mountain breeds, distinct from all others on account of its coarseness and because it is usually found lying loose in the fleece (especially if the latter is examined towards shearing time); it possesses a complete tip and root from which it may be concluded that it is shed at least once a year. Further, it is distinguishable from all other fibres on account of its relative brittleness and its white and more opaque colouration. The former quality is most noticeable in the longer kemps found in the mountain breeds; in these fibres at intervals along their length are found many "breaks" or transverse bends, caused, no doubt, by the movement of the fleece on the sheep's back and the wear and tear to which it is subjected.

Usually kemp is round or oval in cross-section, and for the major part of its length fairly uniform in diameter, only tapering off for a short distance at its extremities. However, in some of the coarser kemps there is a characteristic rigid waving which is accompanied by slight corresponding undulations in diameter. At the tip it runs out to an extremely fine point; at the proximal end the thinning is usually slightly less and terminates in a small bulbous part. The fibre is composed of the same three concentric rings or layers as those found in typical hair fibre, namely, cuticle, cortex, and medulla. The thin superficial ring of the cuticle is rather characteristic. Medially (i.e. in the thickest portion of the fibre) it exhibits a definite reticular structure, the meshes of which are penta- and hexagonal, the sides being very fine and straight, and angles between them clear-cut. Generally they are fairly uniform in size. On examining the cuticular edges under high magnification, it is seen that the more distal edges project a little and overlap the scales above them.

Travelling towards the extremities of the fibre it is seen that the scales become broader and slightly shallower, the apex angle of the scale becomes more and more obtuse until at last it disappears altogether, when the ectal edge, now more clearly visible as such, is represented by a single smooth continuous line. At first sight they now appear to be identical with large wool scales. However, they have a tendency to possess straighter sides and take the form of long narrow rectangles, whereas the wool type exhibits a faintly ragged edge and curves down to meet the superimposed scale without forming any definite angles. These shallow scales continue along the tapering distal end of the fibre right to the point, but at the proximal end, which when complete terminates in a bulb of loosely packed fusiform cortical cells, the cuticular cells are not present beyond the region where the bulb merges into the shaft of the fibre.

The middle or cortical layer is usually very thin, especially in the coarser forms of kemp fibre, but thickens to a short distance at the tapering root and tip parts, which are invariably formed of cuticle and cortex only. It



PART IV., PLATE I.

A—Tip of kemp fibre. ×20.

B—Root of kemp fibre. ×20.

C—Cross-section of kemp with wide medulla. ×250.

D—Longitudinal section of kemp with wide medulla. ×250.

F—Root of kemp fibre. ×100.

appears to be homogenous, faintly striated (except for the bulbous root part described above), but may be dissociated and shown to be composed of similar fusiform cells, which are in this case very closely packed together.

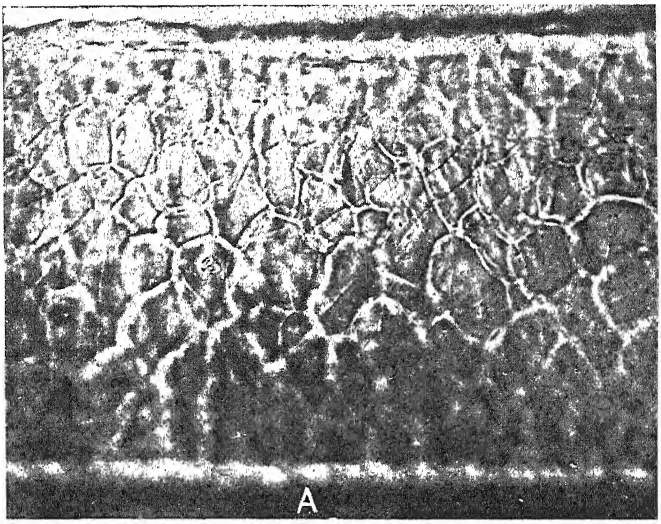
The third or centre part of the fibre—the medulla—takes up in all the coarse kemps by far the greatest part of the shaft, and is enclosed by the other two layers in a fine cylindrical shell. Its structure is reticulate; the meshes which are open, except where occasionally torn septæ stretch across them, run both horizontally and vertically, and are apparently the shrunken cells and cell walls of the original medulla, which before keratinisation may be distinguished from the surrounding cortical cells by their round or square shape, as compared with the spindle shape of the latter. As might be expected from its origin, this medullary tracery is thick and uneven, and stands out clearly, so that in fibres with very thin outer layers it is sometimes mistaken for the superficial scale, the fine outlines of which are only visible under high magnification, and even then it may be with difficulty.

Examined by transmitted light the medulla of a complete fibre of this type shows up as a solid black core on the surface of which the outer meshes are roughly outlined; by reflected light it appears as a similar silver rod. This appearance is caused by a gas filling the medullary interstices, the presence of which may be exhibited by pressing a freshly-mounted fibre between the cover-glass and slide, when the gas will be expelled as a stream of bubbles, leaving the medullary structure more clearly exposed. On releasing the pressure some of the bubbles run back into the medulla, but the mounting medium also runs in and prevents their complete return. This is more easily performed on a broken fibre or one in which the medulla has been cut, for in a complete fibre the medulla is entirely encircled and the cuticular and cortical layers must be burst before its gaseous contents can be expelled.

The white opaqueness of the kemp fibres is also due to a great extent to the presence of this column of gas, and disappears when a dry fibre is subjected to pressure or at a broken or crushed part, leaving a translucent portion comparable with the extremities of wool fibres, where no medulla occurs. To this same cause may be attributed the reputed resistance of kemp to dyes. Actually, kemp and wool fibres dye almost equally well, but the refraction caused by the medulla of the former makes the dye appear relatively ineffective.

Modifications of the above type of kemps may be found, which are less opaque and usually short—from 0·5 to 2·0 cm. in length. Under the microscope the chief divergence from the coarse type is the reduction in the amount of medulla, all grades being found, from the reticulate type already described to a fine discontinuous medulla only one cell wide. The cortex is thicker in these fine fibres, so that their diameter does not vary in direct proportion to the size of the medulla. The reticulate scales of the cuticle are often entirely absent, the fibres being clothed throughout by broad shallow scales.

Great variation in length of kemp fibres occurs but does not appear to be definitely correlated with changes in diameter, for while fine kemps are among the shortest, thick kemps from 1 to 15 cm. or longer are found. In a large number of small samples which were examined the length of the kemp fibres was found to be fairly uniform within one sample, but variation was found to occur between different samples of the same breed. Generally coarser kemps were found in the coarser samples, but there are occasional exceptions to this rule. If the breeds are considered in four groups into



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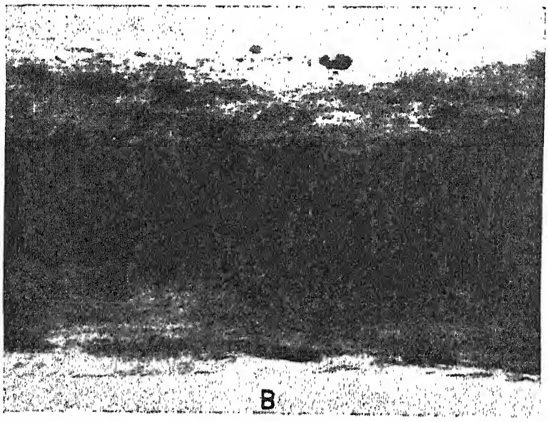

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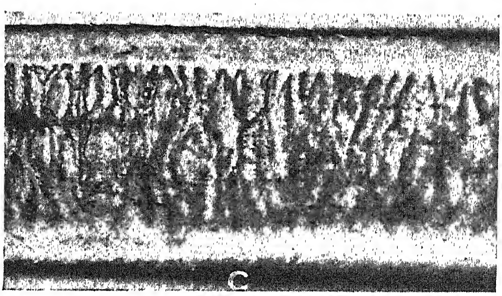


C

PART IV., PLATE II.

A—Kemp fibre with extremely wide type of medulla, showing the fine cuticular markings superimposed on the coarser medullary markings. ×400.

B—Pigmented kemp fibre with fine medulla. ×400.

C—Kemp fibre with medulla of medium coarseness. ×400.

which they can conveniently be classified—Mountain Longwool, Lustre Wool, Down Wool, and Mountain Short Wool—it appears that within each group there is present one modification of kemps which is more typical than the rest. Thus in the Down breeds the kemps are short (0·5 to 2·0 cm.) and have a fine or only moderately thick medulla. In the Lustre breeds they are for the most part of the same length, but extremely thick and possess a very wide medulla. In the Mountain Short Wools kemps reach 3 cm. in length and have a fairly wide medulla. The Mountain Longwools contain long kemps (6–15 cm.) with wide medullæ; the only exception is the Lonk breed in which fibres 1–3 cm. long of moderate coarseness occur.

Coloured kemps, as it is to be expected, frequently occur in wool samples from dark-faced breeds. They occur both separately and in conjunction with other pigmented fibres. The extreme tip and root regions of kemps are always free from pigment and apparently it is also absent in the cuticle. In the medulla it is laid down in minute grains and larger granules irregular in size and shape, but without any apparent pattern. In the cortex the former are arranged in short rows closely packed and lying parallel to the length of the fibre. The larger granules appear irregularly through the cortex either separately or in short strings.

Two kinds of kemp fibres have been found in samples from British breeds which must be considered abnormal in their form. The one which in its extreme form occurs only very occasionally is the type in which the medulla thins down suddenly and disappears at unexpected places; in the medial region, for example, where ordinarily the medulla is at its widest, a short piece may be found where it is entirely absent; as is the case in the normal root part the cortex thickens a little in these regions, but the fibre shaft as a whole is greatly reduced in diameter and the thinning is quite obvious to the naked eye. Quite long thin parts of this kind may occur especially at the proximal end, as if the root part had become enormously extended.

The other abnormal type of kemp fibre is that in which it appears to have been mechanically damaged. Such an appearance is only found in kemps with a very wide medulla. At intervals along the length of the fibre breaks appear which take the form of deep kinks in the side of the fibre or of flattened bends similar to the flattening obtained in a flexible rubber tube, when it is bent back upon itself. In the kinks longitudinal splitting of the outer layers of the fibre occur and the medullary reticulum is compressed in the same direction. Sometimes such a picture is accompanied by the collapse of the medulla in the neighbouring parts of the fibre in which case most of the gas disappears from the medulla and the fibre assumes a twisted and flattened appearance in these parts.

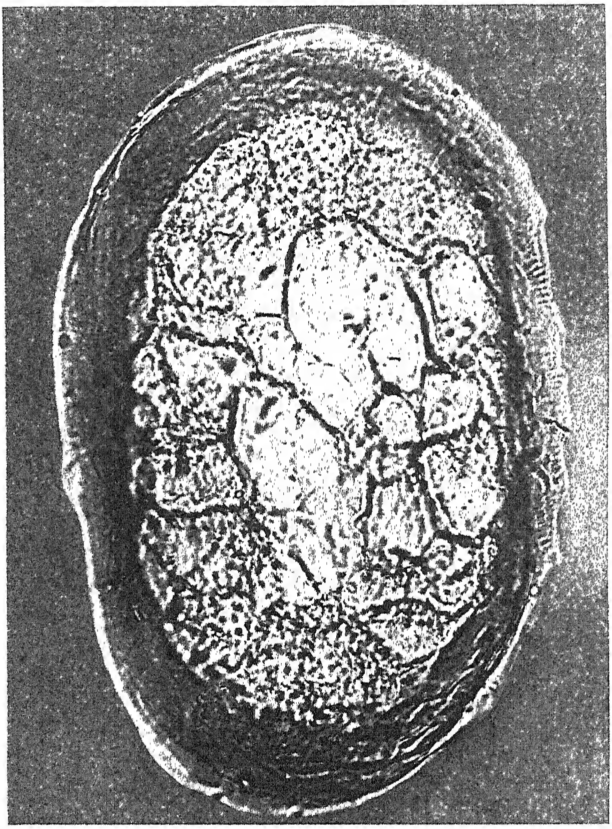
It is generally accepted that kemp is homologous with the hair of the fleece of the primitive breeds of sheep and there would appear to be nothing in the structure and nature of the kemp fibres from British breeds which would lead us to any other conclusion; for while there may be a wide difference between the structure of fine kemps and that of primitive hair, yet coarse kemps are remarkably similar to the latter, and since all gradations between the extreme types of kemps are found, it is reasonable to assume that they are all modifications of one and the same type of fibre.

PART V.—SOME CHARACTERISTICS OF MOHAIR KEMP*

By H. R. Hirst B.Sc., F.I.C. and A. T. King B.Sc., F.I.C.

(The British Research Association for the Woollen and Worsted Industries)

Kemp in mohair possesses the same objectionable features from the manufacturing standpoint as kemp in wool. The characteristics of whiteness



Part V., Plate I.

and lack of strength, elasticity, and apparent dyeing affinity, are due to inclusion of air within a network of cells of honeycomb-like appearance which make up the inner core or medulla of such fibres.

Appearance under the Microscope

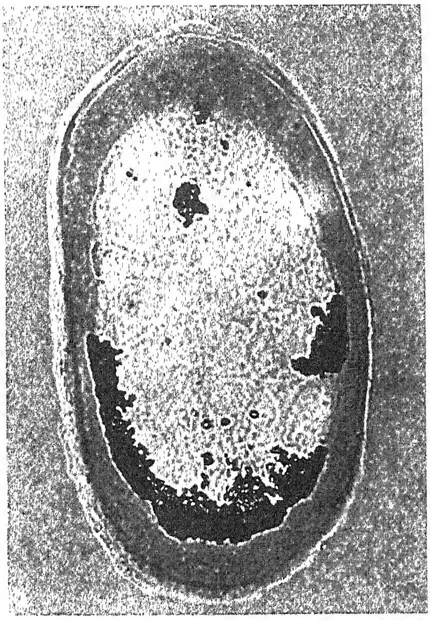
Non-kempy mohair appears, like sheep's wool, to consist only of solid cortical cells sheathed in an outer cuticle, serrated, but less prominently

* These notes are from work carried out in 1921–22 at the instance of the late Mr. Ernest Gates, in connection with the problem of dyeing kempy mohair.

than merino, and more resembling non-medullated Lincoln fibres. It does not contain medulla† (i.e. the inner core running continuously or discontinuously through the fibre, which usually contains air, and is of meshed formation and visibly differs in structure).

Kemp in mohair has not been found as a shed fibre in any of the samples examined. The casual manner of shearing may account in some part for this. The kempy fibres examined all showed cut ends, and it appears that only in the finer grades do the kempy fibres show uncut tips, denoting a new growth.

With the coarser grades the kemp fibres have both tip and root ends cut, and the thickened and heavily medullated portion which usually only



PART V., PLATE II.

runs for about a third of the length of the fibre suggests a marked seasonal variation rather than the annual shedding characteristic of true wool kemps. The regular and continuous medulla traversing the whole length of the true wool kemp, apart from small portions at the extreme ends, has not been found in any of the commercial mohair samples available.

Appearance in Cross-Section

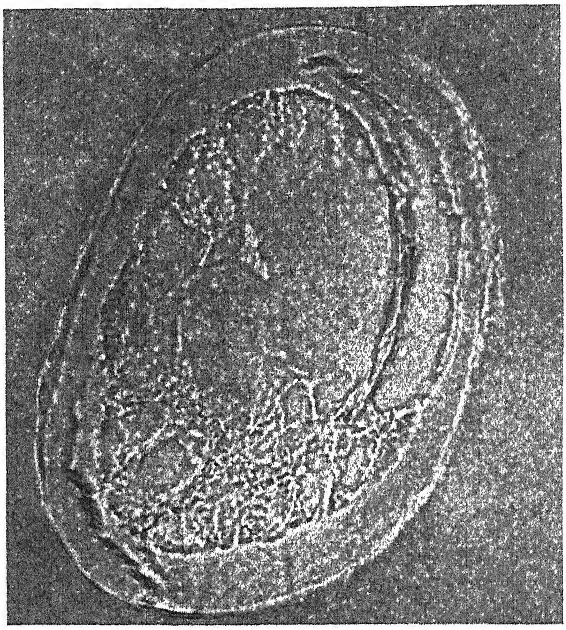
Examination of the fibre lengthwise gives an incomplete idea of the medullary structure, and a clearer insight is obtained from the appearance in cross-section. From the photographs reproduced in Plates I.–VI., it will be observed that the network of hollow cells is continuous across the section.

† Mammalian hairs in general are made of three layers—Cuticle, cortex, and medulla. The fine mohair fibres of the Angora goat are, however, practically free from medulla. A sample of these fine fibres separated from kempy mohair "beard," the lowest grade, showed an average diameter of $2{\cdot}5 \times 10^{-3}$ cm., which corresponds with about 56's quality wool. They are, if anything, more translucent, and softer in handle, than wool of that quality. They are somewhat shorter than the coarse kempy fibres.

The attachment of the network walls to the cortex or solid portion of the fibre is also clearly shown, particularly in Plates I. and VI. Plate II. illustrates the partial replacement of the air from the cells by the mounting medium, the air-containing cells showing up black. These sections were cut with the microtome set for a thickness of 0·002 mm.

Plate III. is of interest as showing a fracture in the cortical layer, and a partial tearing away of the medulla substance.

Especial reference is made to Plate IV., which is a photograph of a wedge-shaped section, obtained after much difficulty by first making an oblique cut and then slightly altering the angle. The section is pared down to practically a single thickness of the medulla structure, and it shows the



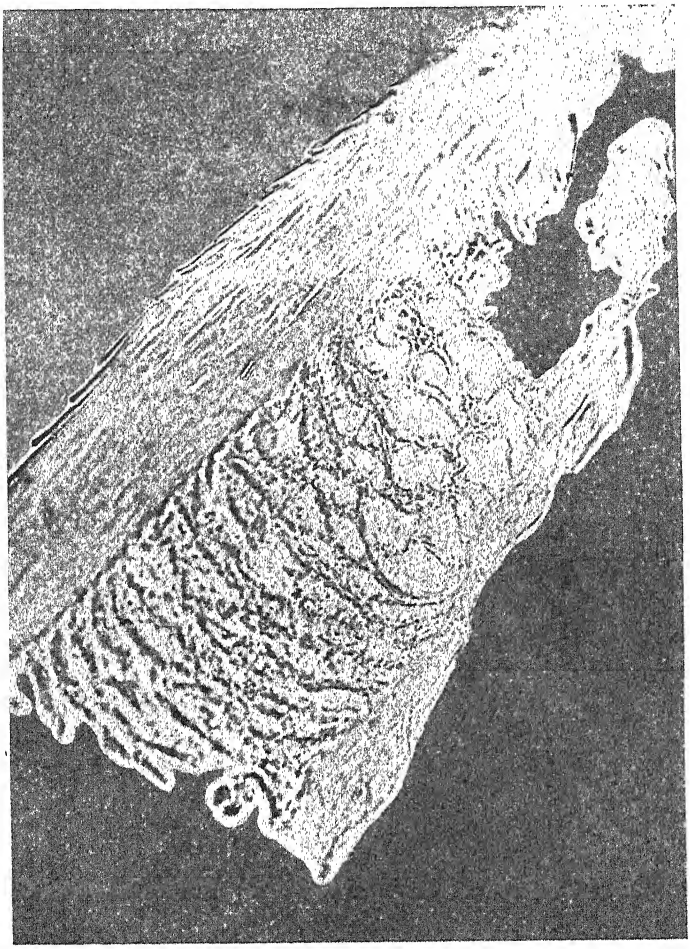
Part V., Plate III.

open nature of this network almost unobscured by underlying layers. Plates V. and VI. show portions of this section under higher magnification.

It will be noticed that the sections as a whole are irregularly elliptical in shape. All wool fibres in fact are stated to be elliptical in cross-section. It may be noted, however, that cross-sections of a perfectly cylindrical fibre would appear elliptical if not cut at right angles to its axis. Also the bean-shaped section in Plate II. might easily be produced from a round fibre containing a yielding interior, with the knife cutting through from the side now showing concave. Markedly flattened fibres are easily recognised by their ribbon-like and twisted appearance when viewed longitudinally, but this is certainly not the case in kempy mohair, which appears very straight and rod-like, even when the solid layer is quite thin.

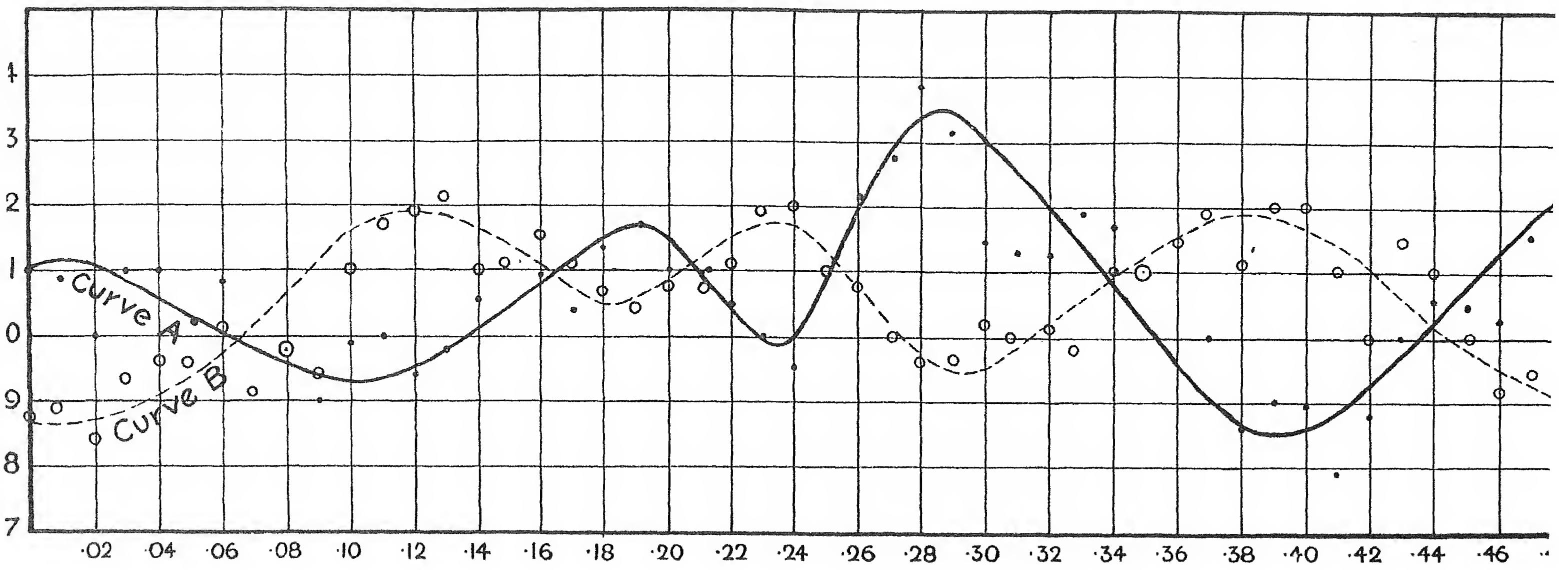
Mohair fibres measured in the Polikeit instrument, which permits of the fibre being rotated without twisting, so that its diameters at right angles can be measured, do not in fact show a marked difference in these diameters, provided the solid layer is not unduly thin. It is worthy of

note that where differences in these two diameters occur, measurements along the fibre show a definite undulation, the major diameter alternating from one direction to that at right angles to it. This suggests a cylindrical rubber rod distorted by applying a torque or twist to one end. The effect is especially observable with merino fibres, but is practically absent with



Part V., Plate IV.

coarse Lincoln fibres. In making these measurements, to avoid confusion in keeping to the same two directions at right angles, observations were taken with successive rotations of 90°, so that when the fibre was moved lengthwise, and the four measurements repeated, they were always in the same directions for every point. The first and third, and second and fourth were then averaged, to give the diameters in the same two right-angled directions along the fibre length. The example given is of an English 56's fibre, measurements being taken at successive intervals of 0·01 cms. along the fibre. The actual diameters are obtained in millimetres by multiplying by 0·0024.



Curve A
Curve B
4
3
2
1
0
9
8
7
·02
·04
·06
·08
·10
·12
·14
·16
·18
·20
·22
·24
·26
·28
·30
·32
·34
·36
·38
·40
·42
·44
·46

A	11·0	10·9	10·0	11·0	11·0	10·2	10·8	10·1	9·8
B	8·8	8·9	8·35	9·35	9·65	9·65	10·1	9·1	9·8
A (continued)...	9·0	9·9	10·0	9·4	9·8	10·5	11·0	10·9	—
B (continued)...	9·35	11·0	11·65	11·9	12·1	11·0	11·1	11·5	—
A	10·35	11·35	11·6	11·0	11·0	10·35	10·0	9·5	10·9
B	11·1	10·65	10·4	10·8	10·75	11·1	11·9	12·0	11·0
A (continued)...	12·2	12·8	13·8	13·1	11·35	11·2	11·2	11·8	—
B (continued)...	10·75	10·0	9·6	9·65	10·25	10·0	10·1	9·8	—
A	11·65	11·1	11·35	10·0	8·5	9·0	8·9	7·9	8·75
B	11·0	11·1	11·4	11·9	11·1	12·0	12·0	11·0	10·0
A (continued)...	10·0	10·5	10·4	10·25	11·5	12·3	12·75	—	—
B (continued)...	11·5	11·0	10·0	9·1	9·4	9·4	9·1	—	—

The smoothed curves, following the trend of the fluctuating values, are shown in the accompanying graph.

Method of Cutting Cross-Sections

The usual method of simply embedding in paraffin wax, or gum arabic and gelatine, is unsatisfactory in the case of wool, as the fibre does not bear sufficiently firmly against the knife edge.

Reisner's method of embedding between two layers of guttapercha, first melting the guttapercha and then laying the fibres parällel and covering with another layer of guttapercha, is rapid, but not suited to the cutting of thin sections in the microtome. For examination by reflected light, however, where comparatively thick sections cut with an ordinary razor can be used, the method is very convenient.

Willows (*J. Text. Inst.*, 1921, **12**, 99) found that cotton cross-sections could be obtained by treating the fibres with a solution of cellulose acetate in acetone before embedding. We have not been able to apply this method satisfactorily to wool fibres.

Completely successful results are, however, obtainable by the method given by Denham (*Nature*, 1921, p. 299), a modification of Brechner's method, to which reference has already been made (Private Report, No. 11, p. 34). It consists in soaking the fibres, first in alcohol-ether, and then in a solution of celluloid in alcohol-ether, after which they are transferred to a chloroform solution of paraffin wax, allowed to soak for two hours, and then quickly embedded in paraffin wax. It is important that the outer layer of wax be thick and firm. The sections, cut to the desired thickness in the microtome, are examined on a slip, and when a suitable specimen is obtained, another slip, coated with a thin film of the albumen-glycerine solution recommended by Denham, is placed carefully over it and gently pressed until the section adheres. After gentle warming to allow the wax to sink flat on the slip, the wax and celluloid are removed by soaking in benzene and acetone respectively, and the section then mounted in an appropriate medium.

We find, however, that with thin sections the albumen layer, which gives a distracting background, can be dispensed with. The wax section is melted flat on a clean slide, carefully washed with successive drops of benzene to remove the wax and mounted with Canada balsam in amyl or butyl acetate. This dissolves the celluloid support or makes it transparent. If required for examination in air, the celluloid support is removed by careful application of butyl acetate, which can generally be accomplished without washing the section off the slide.

Even with very kempy hairs, which are difficult to cut on account of their brittle medulla, and consequent tendency to tear, this method has given very satisfactory results.

PART V., PLATE V.

The Problem of Dyeing Mohair Kemps

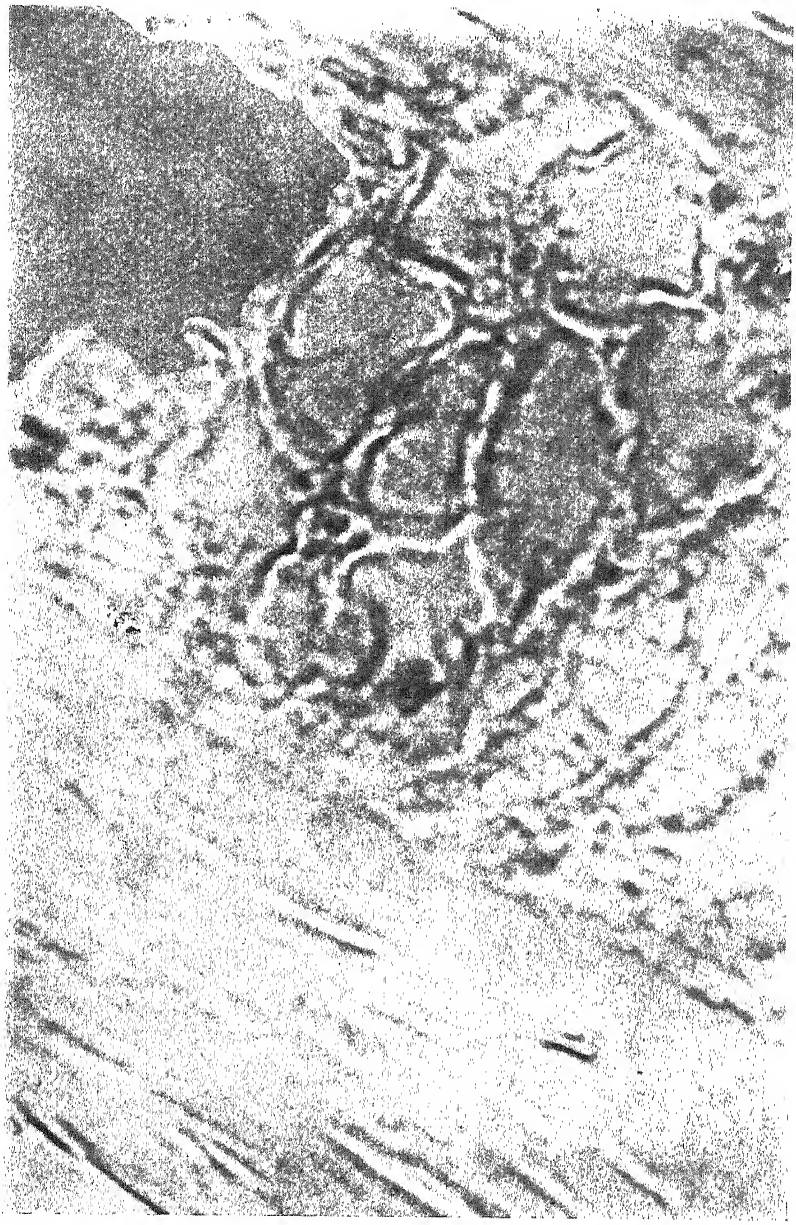
The difference in appearance between a solid fibre and one containing medulla may be compared with that between a solid glass rod and a glass tube filled with small glass fragments. The difference is apparent both with plain and coloured glass. Even if the tube be filled with glass fragments of deeper colour, it may still appear lighter in shade than the rod, owing to the great degree of reflection taking place from the broken interior.

Cross-sections of dyed fibres show the actual medulla substance to be dyed equally with the solid portion. It is thus evident that the trouble is due entirely to the enclosed air, the effect of which shows up with any colour except black or very dark shades.

Thus the solution to the problem requires either the filling up of the air spaces with material of similar translucency to that of the fibre substance, or the breaking down of the interior network. In the latter case the analogy of the glass tube and rod may again be used. A hollow tube more nearly matches the appearance of a rod of glass of the same colour than one packed with glass fragments.

Attempts to solve the problem on the foregoing lines did not yield any satisfactory result. Volatile liquids like alcohol and benzene penetrate fairly readily, but all attempts to introduce materials which would permanently fill the air spaces failed. For example, fibres were placed in gelatine and various other solutions under a high vacuum, with a view to getting the liquid to enter the hollow cells, but the replacement was at the most only partial and chiefly confined to fractured places in the cortical layer. Efforts were made to replace the air by diffusion with soluble gases, i.e. sulphur dioxide and ammonia, but no marked penetration was observed when the treated fibres were placed in an appropriate absorbing medium. Attempts to break down the cellular interior were also unsuccessful. Mercerising with strong caustic soda failed to remove it. Barium sulphocyanide and concentrated bisulphite were without effect. Efforts to minimise the difference in appearance, on the one hand, by giving the mohair as a whole a greater gloss, e.g. by chlorination, and on the other by producing a general matte effect, by treating first with dilute sulphuric acid and converting this into barium sulphate by means of barium chloride solution, were also abortive.

If there is a solution to the problem it appears more likely to be in the direction of mechanical rather than chemical treatment, as it is difficult to conceive a chemical treatment sufficiently drastic to destroy the medulla structure, without impairing the material as a whole.



PART V., PLATE VI.

28—VI.—TENSILE TESTS FOR COTTON YARNS
i.—A SURVEY OF CURRENT TESTS

By Edward Midgley, B.Sc., and
Frederick Thomas Peirce, B.Sc., F.Inst.P.
(British Cotton Industry Research Association)

INTRODUCTION AND SUMMARY

The numerical result of a test depends on many things quite distinct from the practical quality of the yarn, that is its ability to withstand the strains imposed in industrial processes and wear. These foreign effects must be understood and controlled if a sound practical judgment is to be based on the test. In this series of papers the tests available are analysed from this standpoint, the first giving a general survey and an analysis of the lea test, the method most generally used. As the record of experience in this laboratory, this may be of practical utility to other testing departments, though no claim is made that the statements are all original.

The necessity for testing, and more accurate testing, is emphasised under modern conditions by the greater intensity of competition, new developments such as unions with artificial silks and the increasing supply of unfamiliar varieties of cotton. Testing hastens the gathering of experience on the problems thus raised, and puts it on a basis independent of the personal equation. Yarn testing provides the most direct control, for yarn quality limits that attainable in the fabric and is the criterion of the value of the raw cotton.

Tensile strength, for which alone yarn is commonly tested, does not entirely define the textile value, which is also affected by extensibility, elasticity under moderate tension, flexibility, diameter, regularity, external appearance, snarling twist, and resistance to wear. In the ideal test, the routine will be based on scientific method, while the character measured is chosen with a single eye to practical needs.

The objects of testing are to gain information on (A) the textile quality of the yarn, (B) the technique of spinning, or (C) the quality of the raw cotton. Success in the first object is necessary to that in the others, and the test must be made as close an indication as possible of the way in which the yarn will make up into a fabric. Whatever the object, the first condition for a sound judgment is that one variable factor only must enter; for example, to compare two yarns, the conditions of testing must be identical; to compare the efficiency of two cards, draw frames or humidities in spinning, the mixings, other spinning processes and the testing must be kept identical; to compare two cottons, they must be put through the same machines and tested under the same conditions.

The numerical test result, however, on which opinion must be based, depends not only on the textile quality of the yarn, the object of the test, but also on the following factors, taking them as they arise in the test routine—

(1) Sampling.
(2) Nature of test.
(3) Efficiency of instrument.
(4) Atmospheric conditions.
(5) Length of specimen.
(6) Rate of break.
(7) Expression of results.

Faulty control on any of these points may make the test deceptive.

An analysis of each of these factors is given in this and the following papers, though for convenience they are not discussed exactly in the above order.

Sampling and Expression of Results

That the strength of the broken test pieces should yield information on the strength of the batch as a whole, the sampling must be true and the results suitably expressed. Methods of sampling necessarily vary with the object of the test. In general, known sources of variation should be avoided in any single batch, and sufficient specimens from numerous positions tested in order that the result may represent the whole, not merely a chance portion. The arithmetical mean is then taken as the measure of the strength of the batch. To what extent this is true can only be judged from the differences between individual results; the mean alone is not sufficient.

A simple calculation doubles the value of a result, namely, to find the *mean deviation* (M.D.) which is the average difference between the mean and the individual values. Expressed as a percentage this is a sound measure of the irregularity, a low value of which is itself desirable as a regular yarn is more economical of material, easier to handle, and better in the fabric.

Yarn is never designed to bear a strain liable to injure the places of average strength. There is a large factor of safety, and the strength, as a practical quality, depends rather on the number of places where the breaking load falls below a dangerous minimum. This can be found directly from the mean deviation, so also can the probable amount by which the mean obtained may differ from the mean value for the whole batch.

In trying to isolate some effect, such as that of humidity or mercerising or a spinning process, the great irregularity of cotton yarns makes it difficult to measure the real difference caused by the change, for quite large differences may be due to sampling alone. The latter may be diminished by increasing the number of tests, but this adds to the work, and its value is limited by the nature of spinning.

Local irregularities are produced by the variability of cotton hairs and by the way they draft in the final spinning processes, and these are troublesome enough. But, like a ground swell under waves and ripples, longer variations are introduced by changes in the mixing, variations in the lap or in humidity, and by differences between spindles. So irregularity is not diminished by taking larger specimens and samples to the extent expected from calculations on the inch-to-inch irregularity, and the larger a batch of yarn the more irregular it is.

For many purposes this irregularity may be overcome by a simple device, namely, to wind a number of turns on a wrap-reel, fix sticking plaster at two opposite points, and cut into two lots. Each of these *cut-skein samples* contains the alternate threads of the same length of yarn, and the means given by the two are very closely identical when similarly treated and tested. Control tests which are described below show a difference on 40 threads of less than ½ per cent., less than 1/10th the difference on the same number of tests even on consecutive lengths from the same cop. This device has been used when measuring the effects of humidity, rate of loading, tendering by light, acid treatment, rubbing, &c., many of which could never otherwise have been detected, being lost in spinning irregularities when comparison is made between two independent samples. The amount

of testing may be diminished with little loss in precision by winding on a large reel and making a number, say eight, similar samples at a time.

Atmospheric Conditions

To anticipate a more complete account, the breaking load and extension of a 36's Sakel yarn were found to increase by about 5 per cent. of the value at 70% R.H. (relative humidity) for an increase of 10% R.H. Such an example shows that it would be unfair to compare two yarns on results obtained at different humidities, and that all tests should be carried out on yarns conditioned and tested under standard conditions. Taking into consideration normal conditions to which cotton materials are exposed in mills, weaving sheds and warehouses, in use on and off the human body, and the general practice of testing houses, the standard 70% R.H. at 70° F. has been adopted for this work and future testing by the methods described.

The results given in the present papers were obtained in a testing room controlled by a plant which circulates air saturated at a known temperature (the dew point) and maintains the room at a higher temperature. A room may also be controlled by a plant which drives a current of air through either a drying or moistening chamber, according to the properties of a hygroscopic control, the weight of a fabric[5] or the length of animal hairs.[4]

In the absence of full control, the specimens may be conditioned beforehand in a *humidified box*[1], the room humidity being kept as near 70% as possible by heating and ventilation. In the present experiments the specimens were conditioned overnight in such a box, built with double walls of asbestos sheeting and containing control solution, thermo-regulator, and ventilated hygrometer. As a minimum, temperature and humidity records may be kept, but the corrections are uncertain and variable.

Efficiency of Instrument

The breaking load is not directly observed in testing, but only a reading on an instrument scale. The exactitude with which the actual force on the yarn is given depends on the design and calibration of the instrument. The scales are calibrated by the steady reading due to a hanging weight, and even when in perfect order an instrument may give readings different from the actual force because calibration is done with the parts still, whereas in testing they are moving. Under the latter conditions any frictional resistance on parts moved by the recording grip is subtracted from the true tension. A less obvious error is introduced by the momentum of moving parts, if the velocity alters during the tests, for it takes force to change rate of motion. The errors and limitations of machines commonly used, when properly calibrated and in perfect order, are discussed analytically in Paper IV. of this series.

The scale of a *deadweight machine* is very sensitive, the limit of reading being only a fraction of 1% of the breaking load, and small compared with the variations along a yarn, tested on an instrument of suitable range. The friction is negligible if the lever be mounted on ball bearings and the pawls press lightly on the ratchet of the scale. Momentum errors are negligible at ordinary speeds. An eccentric roller (*vide* Paper IV.), which gives a very even scale and rate of loading, greatly improves the single-thread tester used in the present work.

A possible error in the single-thread test may be caused by loss of twist in handling, but can be avoided with due care. Readings of breaking load

can then be accepted as the maximum tension in the yarn, when the machine is properly used. The lea tester is also sufficiently accurate from this point of view.

Extension readings in the lea test, as generally carried out, have little significance and are usually ignored. On the single-thread tester they have great value, and a device is usually incorporated for measuring extension, the simplest being a rod which moves with the lower grip till rupture. Its efficiency depends on a nice adjustment of the weighting of the lever on the lower grip, and the friction which holds the rod after rupture of the specimen. The initial tension affects the extension reading. It may be adjusted by hanging a weight on the specimen before fastening in the lower grip or by a slight displacement of the recording lever, but the advantage is doubtful, as this increases the danger of loss of twist and slip in the grips and the tension may be altered in fastening. The apparent extensibility may also be altered by previous tension, as in winding, which takes out a useless, inelastic extension without causing any real change in extensibility as a practical quality. The reading scale is not sensitive, about 1 in. movement in all, even on long spans. In fine, single-thread extension measurements need close watching, and some degree of uncertainty attaches to such results.

The *Moscrop machine* performs the single-thread test automatically at a much greater rate than the standard deadweight tester, giving a permanent record, and there is little danger from loss of twist. It is shown in Paper IV., however, that these advantages are accompanied by serious momentum errors unless the speed is reduced below the usual rate of 8 cycles per minute, especially with weak yarns. The operation is seriously affected by careless treatment of springs and by dirt on bearings, there being much more to go wrong than in deadweight machines, but the springs are accurate at all speeds and the friction is negligible when the machine is in good working order.

The scale is as sensitive as the regularity of yarns demands, for it was found by trial that neither the mean nor the mean deviation was appreciably changed by reading to one-tenth of an interval. The pendulum type of scale is, indeed, unnecessarily sensitive, and the large intervals of the Moscrop record are a distinct convenience in calculation.

Nature of Test

Let it be granted that a good representative sample has been taken, tested under controlled conditions on a reliable instrument, and that a mean figure of known statistical significance has been obtained which truly describes the batch under test. What information does this figure give as to the real strength of the yarn, that is, whether it will stand processing or will break in winding, doubling, dressing, weaving, or knitting? This depends on the nature of the test itself, and its relation to the strains which the yarn has to stand in practice.

Actually, yarns are not often employed for lifting weights, like a metal chain, and the effective strength of a yarn depends more on the amount of quick extension it can undergo without injury than on breaking load. The usual test for metals is, quite soundly, to measure the force which injures or breaks the specimen under a slowly increasing tension, and this has been adopted as the standard test for textiles. Many other tests—wear, oscillating, stress-strain, ballistic—are conceivable and practicable,

which may give better measures of strength. But though the information it gives is not so directly practical as in the case of metals, the breaking load under steadily increasing tension is a simple criterion, and necessary to the full interpretation of more thorough tests, description of which will be deferred to subsequent papers.

Determined as it is by the slipping and rupture of fibres at the weakest part of the length, the breaking load is not a single-valued quantity characteristic of the yarn alone, but depends on the rate of break and the length of specimen, which may vary in different tests and processes of manufacture.

The effect of the rate of break is described in Paper III. of this series, where it is shown that the yarn offers more resistance to a rapid strain but breaks at the same extension.

Length of Specimen

The longer the specimen of a given yarn the weaker will its weakest spot be on the average, hence the lower the mean breaking load, irregular yarns showing the greatest change. The effect is analysed mathematically in Paper V., where necessary relations are found between the mean strength and irregularity of specimens of different length. Experimentally it was found that the breaking load dropped by about 6% on increasing the length of specimen from 10 in. to 30 in., whilst the extensibility decreased in direct proportion and the mean deviation of breaking load by about 10%. Within the limits of statistical uncertainty, and allowing for known deviations from the normal random distribution of strength, the observed effect of the length of specimen agreed with that deduced theoretically.

From the standpoint of making test results agree with practical behaviour, it is advisable to test lengths of the same order as the free length under tension in processes such as winding, doubling, dressing, weaving, &c. A long specimen, the usual 24 or 27 inches, is desirable on this account as well as because of the greater regularity and more accurate measure of extension.

The Lea Test

In this, the most universal yarn test, a lea of 120 yards is tested in the form of a skein by a gradually increasing tension, which distributes itself more or less evenly among the 160 threads. The thread in which the tension first exceeds the breaking load snaps, others follow, the remainder begin to slip, and the machine records the maximum force transmitted during this process.

Yarn is not used in the form of such skeins, the strength of which is only of interest as a guide to the average strength of individual threads. The criterion by which to judge the results of the test is then the ratio between the lea strength and that of 160 single threads, which will be called the "lea ratio" and expressed as a percentage. As it is not nearly 100%, the lea test is certainly not a direct measure of thread strength. It is usually about 75%, but may vary even from 50% to 90%. The test is therefore not a reliable index to thread strength, for obviously it may make a yarn appear weaker than another when it is really half as strong again.

To inquire what the result depends on and what it really measures, it will be found convenient to divide the total result into two parts, (A) the load registered when the first thread breaks, and (B) the increase that occurs during the process of breaking and slipping. They depend chiefly on the

yarn properties, (1) thread strength and its variability, (2) extensibility and its variability, (3) roughness; and on the testing conditions, (4) placing on the hooks, (5) rate of break.

Even single-thread strength shows a variation with the *rate of break*, but this is a real property of the yarn and inappreciable over the range of speeds of lea testing. The effect on apparent lea strength is more serious as high speed gives the threads near a broken one less chance of slipping, thus increasing the indeterminate part (B) of the result. Standardising the rate of fall of the lower jaw does not ensure the same rate of break on different machines, and even on the one instrument weak specimens are broken more quickly than strong ones. Gégauff[2] has noted that strong leas give a lower lea-ratio than weak ones. It is not practicable to arrange for a constant time of break, and it is best to minimise the indefinite portion (B) of the load by reducing speed. The practice of exaggerating the result by speeding up the machine exaggerates its errors only.

A great difference in the evenness of tension and gripping of the threads may be made by the manner of *placing the lea on the hooks*. Comparison tests showed that a difference of about 15% was made by releasing one end of the lea after winding, this causing the threads to overlap one another in the test. Even putting the lea on with a twist or half-hitch made less difference. A considerable part of the result is still of the type (B) when the lea is in the form of a ribbon, without overlapping of threads. This is shown by the fact that the strength per thread is about 15% less for quarter leas than for full leas, though the first break must occur at a lower tension in the latter.

No definite relation can be found between yarn properties and lea ratios in the ordinary test in which the result varies indeterminately between that which would be given if the threads could not slip at all and if the maximum reading occurred when the first thread breaks. The latter figure can be simply calculated from the analysis given in Paper V., from the mean single-thread strength and the mean deviation of the extensibility. It can be realised by testing quarter leas in a regular band at a reduced speed, the resulting figure being a useful measure of single thread quality, especially as the regularity of extension is a useful property itself. In the ordinary test, results on five types of yarn give an average lea ratio of 81%, calculated ratio to the first break of 71%, the difference being due to a very irregular addition of load after the first break. The iregularity of lea strength was found to be of the same order as that calculated, which is much greater than that of the mean of 160 threads. In fact, 8 single-thread tests give a mean as precise as the result of a lea test. These conclusions are supported by an analysis of extensive data on single-thread and lea strength given in a recent paper by Hall.[3]

DESCRIPTION OF EXPERIMENTS

Control Test on Single-Thread Strength of a Pair of Cut-Skein Samples

The mean breaking load in grams on 40 threads of 36's Sakel unsized yarn was—

(*a*) $359{\cdot}7 \pm 3{\cdot}3$ Difference $1{\cdot}6 = 0{\cdot}45\%$ of the mean.

(*b*) $358{\cdot}1 \pm 4{\cdot}7$ P.V. of difference $= \sqrt{3{\cdot}3^2 + 4{\cdot}7^2} = 5{\cdot}74$.

If one set had been treated, e.g., mercerised, the difference shown would have been almost entirely due to that treatment, even though, from the

variability of each lot taken by itself, only a difference of $3 \times 5{\cdot}74 = 16{\cdot}2$ would be regarded as significant. Disregarding the division into two complementary sets, the mean breaking loads were—

First 40 lengths 370·5.

Second 40 lengths 347·3. Difference 23·2=6·47%.

Had one set of tests been made on 30 yards of yarn and another on the next 30 yards, the difference due to sampling alone would have been 23·2, fourteen times that between the sets of alternate threads, and any small effect due to treatment would have been entirely swamped.

Control Test on Sized Yarn (otherwise as above).

(*a*) $399{\cdot}0 \pm 4{\cdot}7$ Difference 1·2=0·30% of the mean.

(*b*) $397{\cdot}8 \pm 5{\cdot}7$ P.V. of difference 7·4.

Length of Specimen

If the breaking loads of short specimens be distributed about a mean value according to the normal law of deviation, then the decrease in the mean for a greater length is proportional to the mean deviation for the short length and to a factor depending only on the ratio of the lengths. If r be the ratio, v the factor,

$$v = 5{\cdot}3\ (1 - r^{-\frac{1}{5}})$$

very approximately. The variability also decreases, so that the ratio of the mean deviation of the long to that of the short specimens (u) is $r^{-\frac{1}{5}}$.

The variation with length was measured on several yarns by testing alternate specimens of 10 and 30 inches, also by measurements on consecutive lengths of 10 and 30 inches, with the results shown in Table I. (Variability is measured with a little more accuracy by the Standard Deviation, the square root of the mean square deviation. This was used in analysing these results, the M.D. given being 0·798 times the S.D., as for a normal distribution).

Table I.

Observed Effects of Length on Single-Thread Test.

Sample	No.	Length	Breaking Load in gms.	M.D.	Extension %	Difference of Breaking Loads, grams
36's Sakel	277	10″	$367{\cdot}8 \pm 1{\cdot}5$	28·8	6·84	
(*alternate*) ...	277	30″	$359{\cdot}6 \pm 1{\cdot}3$	26·5	6·96	$8{\cdot}2 \pm 2{\cdot}0$
36's Sakel	100	10″	$392{\cdot}9 \pm 2{\cdot}6$	31·2	7·82	
(*consecutive*) ...	100	30″	$370{\cdot}3 \pm 2{\cdot}0$	23·7	6·91	$22{\cdot}6 \pm 3{\cdot}3$
32's American ...	200	10″	$207{\cdot}4 \pm 1{\cdot}2$	17·6	6·01	
Ring Yarn ...	200	30″	$196{\cdot}4 \pm 1{\cdot}1$	16·0	5·93	$11{\cdot}0 \pm 1{\cdot}6$
20's Waste	200	10″	$264{\cdot}0 \pm 2{\cdot}9$	49·1	8·50	
(*alternate*) ...	200	30″	$235{\cdot}4 \pm 2{\cdot}8$	46·6	5·97	$28{\cdot}6 \pm 4{\cdot}2$
20's Waste	100	10″	$291{\cdot}0 \pm 3{\cdot}1$	36·5	7·83	
(*consecutive*) ...	100	30″	$236{\cdot}9 \pm 3{\cdot}6$	42·6	6·68	$54{\cdot}1 \pm 4{\cdot}8$
32's American ...	600	9″	$234{\cdot}1 \pm 0{\cdot}7$	19 4	7·24	
Ring Yarn ...	600	27″	$220{\cdot}0 \pm 0{\cdot}6$	17·5	6·81	$14{\cdot}1 \pm 1{\cdot}0$

When the length is trebled, the theoretical difference is 1·05 times the mean deviation of the short length; the M.D. of the longer specimens is 0·74 times that of the shorter. As these values are based on probability

considerations, the actual ratios over 100 or so specimens must vary widely. The observations show an invariable decrease with length, the changes being greater in the more irregular yarns and of the order to be expected. The M.D. also decreases, but less than the theoretical amount.

The most crucial test is that shown at the bottom of Table I. The samples were two complementary sets of 30 lots of 20 threads. The M.D. of breaking load was found on each lot separately, the mean value for 9″ specimens being $19{\cdot}42 \pm 0{\cdot}58$, for 27″ specimens $17{\cdot}53 \pm 0{\cdot}52$. The ratio of these is $0{\cdot}903 \pm 0{\cdot}038$, which is greater than the theoretical 0·74 by 4·3 times its probable error. Of the 30 differences between the means of complementary twenties, 28 showed the 9″ threads stronger, the mean being $14{\cdot}1 \pm 1{\cdot}0$. The theoretical difference is $1{\cdot}05 \times 19{\cdot}42 = 20{\cdot}4 \pm 0{\cdot}6$. The difference between these two values is 5·4 times its probable error. The ratio of the percentage extensions is 0·94, the same as the ratio of breaking loads.

The changes are significantly less than those deduced from a normal random distribution, as that does not apply strictly to a yarn. The average difference between consecutive pieces is less than between pieces taken at random and it is the former that determines the effect of length. When multiplied by 0·707 ($1/\sqrt{2}$) it should give a figure the same as the mean deviation, if the distribution be normal. Calculated from the consecutive threads, this figure was for 36's Sakel 28·1 against a M.D. of 31·2, for 20's waste 30·6 against 36·5.

For any given thread, the curve of load against extension is very nearly a straight line. The total extension is merely the sum of the extensions of all the portions, consequently the extension as a percentage of the length should be proportional to the breaking load, when the length of specimen only is altered. Measurements of extension are less accurate than those of breaking load, and therefore show more irregular variations, but on the whole a decrease is shown of the same order in percentage as that of breaking load. (The extension of the waste yarn was particularly irregular, as specimens often extended considerably between maximum tension and complete rupture.)

Lea Test

Mounting of Specimen—A great difference in the evenness of tension and gripping of the threads may be made by the manner of placing the lea on the hooks. To estimate the possible variations, comparison tests were carried out on leas wrapped from the same cop and placed in six different ways. (1) *Ribbon*—The lea, spread evenly on a wrap reel, was transferred carefully without allowing the threads to touch or overlap. (2) *Normal*—The wrapped lea was held at both ends to prevent twisting. (3) *Band*—The lea was held at one end only, and straightened by running a finger along it before placing. (4) *Half-twist*—The two ends of the lea were placed on the hooks from opposite sides, i.e., to give one longitudinal half-twist. (5) *Half-hitch*—An extra turn was given over one hook, two parts of the band overlapping. (6) *Unequal Tension*—The last ten of the eighty turns were $1\frac{1}{2}$″ less in circumference. The mean strength by method (1) on 14 cops of 20's Indian yarn was 61·2 lbs., and the mean ratios between the results by each method, and that of method (1) were—

Ribbon	Normal	Band	Twist	Half-hitch	Unequal Tension
100	$101 \pm 1{\cdot}7$	$115 \pm 2{\cdot}6$	$108 \pm 3{\cdot}1$	$108 \pm 2{\cdot}3$	$86 \pm 1{\cdot}7$

In the last, the 20 tight threads (12·5% of the lea) break or slip without contributing to the final load (14% less than that of the lea), but give enough friction to allow the remainder to show its full strength.

The first five results illustrate well the effect of increasing friction. The second type of lea is drawn by the tension into a ribbon similar to the first and shows no significant difference. In the third, many threads overlap and grip each other rigidly towards the end of the test, greatly increasing the portion (B) of the load. In the fourth and fifth the friction is further increased, but now to such an extent that the tension cannot distribute itself in the earlier part of the test, thus decreasing the portion (A).

The comparison between ribbon and band was repeated on a gassed 60's West Indian yarn. The mean of 20 values of the ratio was $112 \pm 0{\cdot}9$. Method (3) is probably closest to ordinary practice, but it gives the worst conditions, for the added load is a chance thing, incapable of control or interpretation as a yarn quality.

Whilst careless mounting increases the fiiction between the threads, this may be further diminished by testing smaller skeins. Leas, half-leas, and quarter-leas were wrapped in rotation from a cheese of 60's West Indian yarn to a total number of 72 of each size and tested, by method (2), with the following result—

No. of threads ...	160 ...	80 ...	40
Mean breaking load ...	42·3 ...	19·1 ...	8·86 lbs.
Ratio per lea	100 ...	$90{\cdot}4 \pm 0{\cdot}7$ ...	$84{\cdot}4 \pm 0{\cdot}9$

As the strength should *decrease* with length, and the break is slower for the full leas, the friction on the hooks of 80 turns is responsible for a considerable addition of load, even when the mounting is careful. By observation, no addition of load occurs after the first break in a quarter-lea, but a decided increase with full leas, although direct quantitative measurement of the portion (B) could not be made with precision.

Yarn Properties—Many attempts have been made to find some relation between observed "lea ratios" and various properties of the yarn. Smith[6] states that the ratio is greater for low twists, which may be due to the effect on extensibility or surface friction, and to the fact that the highly-twisted yarns are generally the stronger. The factors that may affect the chance process of breaking and slipping are so complex, and the empirical relations so irregular, that there is no hope of improving the significance of the test as it stands by such observations. It can only be given definite meaning by a logical analysis and by bringing it into relation with calculable and reproducible conditions.

Three cases of such conditions may be distinguished—(*a*) a long continuous thread in which the tension remains uniform, (*b*) a set of threads gripped at the ends so that the extension is uniform, (*c*) the same but slipping after the first break. The degree to which an actual test approximates to one or other of these cases depends on the friction at the hooks.

Using a full lea with threads overlapping, the test makes a rough approximation to (*b*). The portion (B) of the load after the first break is not, however, that given by the theoretical condition, but varies with the speed, the number, roughness, and extensibility of the threads and the manner of mounting. Even if the threads are held in a positive grip, the maximum load is not related to thread strength as simply as in the other two cases (see further, Paper V.), and there are more practical difficulties. Trial

tests gave erratic results owing to a kind of tearing, the distribution of tension among the threads depending on the position of the threads first ruptured.

Cases (*a*) and (*c*) give a simple relation. The "lea ratio" is less than 100 by v times the irregularity; where v is the same factor as before and the irregularity, the mean deviation as a percentage of the mean, is for (*a*) that of the breaking load, for (*c*) that of the extension. As the manner of break depends on the friction between the yarn and the hook, measurements were made of this which are described in Appendix I. The coefficient of friction is 0·15 and the ratio between the tensions on two sides of a half turn over the hook which the friction can maintain is about 1·6. This is not sufficient to maintain any appreciable differences of tension at the beginning of a test, i.e., when all the tensions are small, provided the lea is wrapped evenly without overlapping, nor to allow an increase of load after the first threads break. On the other hand, the differences in tension developed by differences in the load-extension ratio are insufficient to cause slippage, so that the actual conditions of the test can be made to approximate very closely to case (*c*).

In such a case the portion (B) of the load is reduced to insignificance, and the portion (A), the whole result, gives a "lea ratio" depending only on the irregularity of extension and the factor v, which is 3·38 for 160 threads. The mean deviation of the extension will be $160^{-\frac{1}{5}}=0{\cdot}36$ of that of the breaking extension of single threads and the irregularity of lea strength the same as that of lea extension as the variation of the mean ratio of load to extension over batches of 160 is negligibly small.

Results obtained on several yarns are given in Table II. with the calculated and observed ratios between single-thread and lea tests. A very large number of observations would be necessary to fix the lea ratio and the mean deviation of extension accurately enough to test a statistical theory. but these results are sufficient to show that the calculated load at first break is of the same order but rather less than the observed lea strength. The irregularity is not significantly different from that calculated. The lea test has not the statistical significance of 160 single-thread tests, but of 8 only.

Table II.

Comparison of Single-Thread and Lea Strengths.

Sample	Lea Test			Single Thread Test					Lea Ratio		Lea Irregularity Calculated
	No. of Tests	Lea Lbs.	Irregularity	No.	Thread Oz.	Irregularity	Extension %	Irregularity	Observed	Calculated	
60's West Indian ...	10	37·5	6·4	200	4·81	10·4	3·8	8·0	78	73	4·0
36's Sakel ...	20	106·8	3·9	277	12·69	7·3	7·0	6·5	84	78	3·0
32's American	20	62·8	3·5	200	6·94	8·1	5·9	7·2	90	76	3·4
20's Indian	32	64·5	4·6	160	8.48	10·3	5·6	9·0	76	70	4·1
20's Waste ...	8	63·2	3·2	200	8·30	19·9	6·0	12·9	76	56	8·2

The conditions of case (*a*), which give the simplest relation to single-thread strength, could be realised by winding thread over a number of small independent pulleys, a method only practicable for a dozen or so strands. The lea test as it stands can best be improved by testing quarter-leas as untwisted ribbons at half the usual speed, when the portion (B) is eliminated and the conditions of case (*c*) realised.

APPENDIX I.

Yarn and Hook Friction

When a thread passes over a cylindrical bar, in contact over a semi-circle, the friction just equals the difference of tension when the ratio of the tensions on either side is a constant which depends on the frictional co-efficient of the thread and metal. If the thread just moves under a tension T_1, and the opposing tension be T_0, then

$$T_1/T_0=e^{\mu\pi}=a$$

where μ is the coefficient of friction.

T_1 and T_0 were measured directly by hanging two pans on a thread passing over the upper brass hook of the lea tester, and adding lead shot one by one till movement just persisted. By loading each pan alternately a series of values was obtained with increasing tension.

A quicker method, involving both hooks of the tester, is to tie one end of a thread to one of the hooks and pass it several times round the hooks, suspending a known weight from the other end. If the load be T_0, and the lower hook be traversed at a constant speed, the force on the upper hook when the load is being raised is

$$T=T_0(1+a+a^2+\cdots\cdots\cdots),$$

the number of terms being equal to the number of threads, and

$$T=T_0(1+\frac{1}{a}+\frac{1}{a^2}+\cdots\cdots\cdots)$$

when the load is being lowered. A large number of values of a can be quickly obtained with different loads and numbers of turns. The force on the upper hook is measured on the dial of the tester, the bob and pawls being removed from the pendulum.

Using these methods on six threads of 36's Sakel, a mean value of 0·153 was obtained for μ. A value of 0·151 was obtained on 20's waste yarn and of 0·153 on 60's West Indian. The value is that between brass and the surface of the cotton hair, and is independent of the structure of the yarn. The value of a corresponding to $\mu=0·152$ is 1·61.

APPENDIX II.

In a paper published recently[3] some data on hank tests of wool are given, with the number of strands varying from 1 to 128. They show excellently the drop of breaking load due to variability of extension, from 1 to 32 threads, after which the mutual support of the more numerous threads introduces the additional load (B) and a slight rise. Table III. shows the data (Table A, *loc. cit.*) fitted to the formulæ of the theory used above. When the breaking loads are fitted for 1 and 32 threads, a very probable value is given for the irregularity of extension and the formula fits the earlier observations, falling below them for the 128 strands. The standard deviations follow the $r^{-\frac{1}{2}}$ series, with which they are compared, as closely as the number of tests would allow.

The conclusion drawn by the observer[2] that the rise for larger hanks is desirable, and gives a closer approximation to the "true" value as shown by single thread tests is the very reverse of the real meaning of the curve, for the fall is significant and calculable, the rise adventitious and of no useful meaning. It appears to vary widely even among the three yarns of this table, being less for the smoother worsted yarns.

The decrease of strength when the hanks are clamped could not possibly occur if the initial tension were uniform and the specimen loaded evenly, but agrees with the experience in this laboratory. A sound test cannot be hoped for along that line.

Table III.

Variation of Strength per Thread with Number of Threads.

Yarn	Threads	Tests	Breaking Load ÷ No. of Threads Observed	Breaking Load ÷ No. of Threads Calculated	Standard Deviation Observed	Standard Deviation Calculated
			gms.	gms.		
2/32's Worsted $a_r = a_1 - 16v$	1	200	316	320	35	34
Irregularity of Extension =	4	60	311	304	27	26
5·0%	8	40	301	296	22	22
	32	19	277	286	14	17
	64	20	279	282	9	15
	128	20	284	278	11	13
2/36's Worsted $a_r = a_1 - 15v$	1	120	270	270	25	25
Irregularity of Extension =	2	60	262	262	18	22
5·6%	4	60	255	255	20	19
	8	60	254	248	22	17
	32	12	229	238	9	12
	64	12	230	234	10	11
	128	12	241	230	6	9
16's Woollen $a_r = a_1 - 40v$	1	200	347	347	50	60
Irregularity of Extension =	2	100	333	325	49	52
11·5%	4	50	306	305	51	45
	8	36	289	288	50	40
	16	24	249	275	37	34
	32	24	267	262	30	30
	64	24	288	251	50	26
	128	24	300	243	23	23

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29—VII.—TENSILE TESTS FOR COTTON YARNS
ii.—THE BALLISTIC TEST FOR WORK OF RUPTURE

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INTRODUCTION AND SUMMARY

There is no doubt that, other things being equal, an improvement in spinning or in the quality of cotton and in the resulting yarn quality will usually be shown in an increased breaking load of the yarn. In the more general uses of testing, however, the latter is not a direct measure of useful strength, for the test is so far removed from the strains which are liable to injure a yarn in practice. These are rather in the nature of sharp plucks, and the quality needed in the yarn is the ability to stretch without injury as well as to stand a definite load.

Tendering usually diminishes both the breaking load and the extension, but some treatments increase the load while decreasing the extension, in which case it will probably be found that the yarn is, for practical purposes, tendered. As an example, it was found that a dyed yarn broke every few yards in dressing, though the grey was of good strength. The dyed and grey yarns were compared by single-thread and by the ballistic test to be described, one set of results being shown here—

	Breaking Load, ozs.	Extension %	Ballistic Work
Grey	$4{\cdot}84 \pm_{.07}$ ...	$4{\cdot}17 \pm_{.11}$ ...	$111 \pm_{3.4}$
Heliotrope ...	$5{\cdot}63 \pm_{.09}$ ...	$3{\cdot}21 \pm_{.07}$ ...	$98 \pm_{1.2}$
Difference ...	$+0{\cdot}79 \pm_{.12}$ ...	$-0{\cdot}96 \pm_{.13}$ ...	$-13 \pm_{3.6}$

According to the breaking load, the yarn had been considerably strengthened by dyeing, but the dresser knew, what the ballistic test showed, that it was seriously tendered, owing to the loss of extensibility.

The most complete test for the tensile properties of a yarn is to find the relation or curve connecting the extension and the load at each moment from the beginning of tension to rupture. Examples of such curves, which are given below, show that extensibility alone is a very uncertain guide to quality, for unresistant, inelastic extension is of little value. This is shown by the curves of a yarn when first straightened, the plastic flow of Celanese near rupture or the slow pulling out of yarn spun to too high a count for its staple. Real quality is shown by extensibility combined with a resisting tension. The work or energy absorbed in rupturing a yarn is the sum of each increase of length multiplied by the tension producing it. If the ratio of extension to tension remains the same, this work of rupture is $\frac{1}{2} \times$ breaking load $\times$ extension. This is very approximately the case for sized yarns; with unsized yarns the extension is less resistant at low tension than near rupture, and the factor is rather less than $\frac{1}{2}$; with artificial silk,

the extension is more resistant at low tension and the factor is more than ½. Work of rupture is thus a measure of combined strength and extensibility which takes into account the behaviour over the whole range up to rupture.

Whilst a thread will suffer the same extension to a very close approximation whether broken slowly or rapidly, its resistance and final breaking load increase considerably with the rate of loading (Paper III.). The test should therefore be performed as nearly as possible at the same speed as the strains encountered in practice, which are undoubtedly not slow steady extensions but rapid jerks. Fortunately, the work absorbed in a rapid break is capable of convenient measurement by the ballistic method. This test is being used increasingly on metals and other materials, but in no field are its advantages so decided as in textile testing. The earlier applications of the principle and its possibilities are discussed in a previous communication,[5] the work of Lester[4] being the first and especially noteworthy. Denham[2] has recently used the test on silk thread, and the principle has been applied to testing cotton hairs by Balls[1] and Foster.[3]

The Ballistic Tester

The tester described below has been developed with the object of providing a test as convenient as those in vogue for commercial purposes, while giving a result of exact and scientific meaning. It is introduced on the grounds that the quantity measured is the most significant single measure of yarn strength, but its use might equally be justified from the viewpoint of testing routine. The breaking load must be measured laboriously on single threads, or accuracy sacrificed in breaking a skein of which the apparent strength depends on the order in which the individual strands break. The ballistic tester measures the total amount of energy absorbed, which is unaffected by the order of breaking or the number of threads.

Work, mechanical energy, is performed when a point is moved against the resistance of a force, e.g., in the extension of a yarn against its tension or the raising of a body against its weight. In the latter case, the work reappears as energy of movement when the body is dropped. This kinetic energy can be used to extend and break a yarn or lea of yarn. In the ballistic tester (Fig. 1) the falling body is a heavy pendulum (A) which is released from a known height. If no work is done in the swing, the pendulum rises to the same height in its upward swing. If it is made to break a specimen (B) it rises to a lower height and the difference between the two heights gives a measure of the energy absorbed in rupture.

The fixed anchorage (C) is placed so that the specimen becomes taut when the bob is about 1 in. from its lowest point, and it can be adjusted for lengths of yarn from 10 in. to 30 in. The specimen is fixed in two small detachable grips, of which a number are kept at hand, by two serrated plates screwed together. These are hooked over round bars on the anchorage and at the point of percussion of the pendulum. The releasing catch (Fig. 2) engages a square bar on the pendulum automatically when the latter is pushed against it. It can be moved to any height on an arc (D) with no more trouble than the turn of a thumbscrew. The height to which the pendulum rises is recorded by a light aluminium pointer (E) held stationary by the light pressure of a pawl on the top edge of the recording arc (F). Both arcs are graduated in equal intervals of height which in the present instrument are 1/10th and 1/100th of the radius, but could as easily be made to correspond

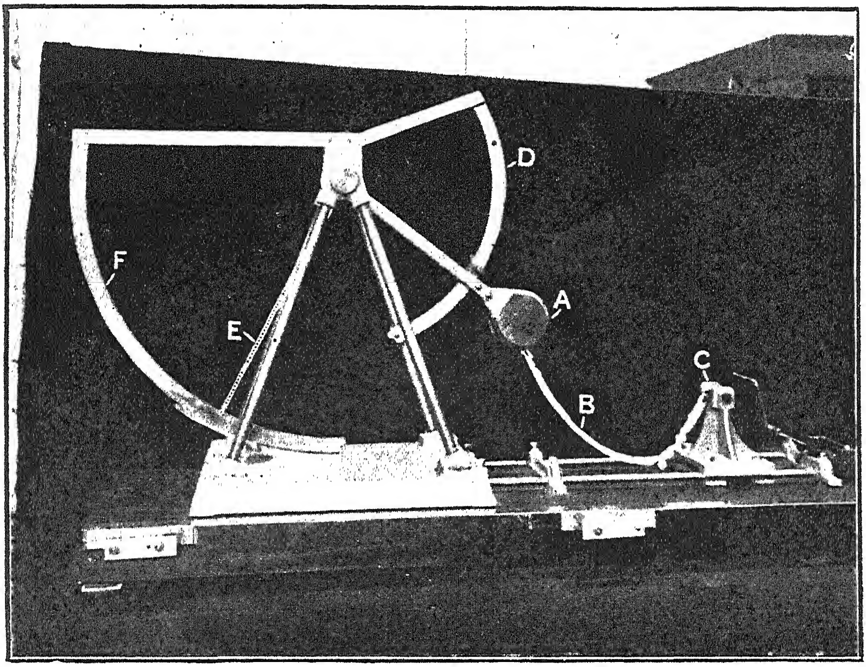

FIG. 1

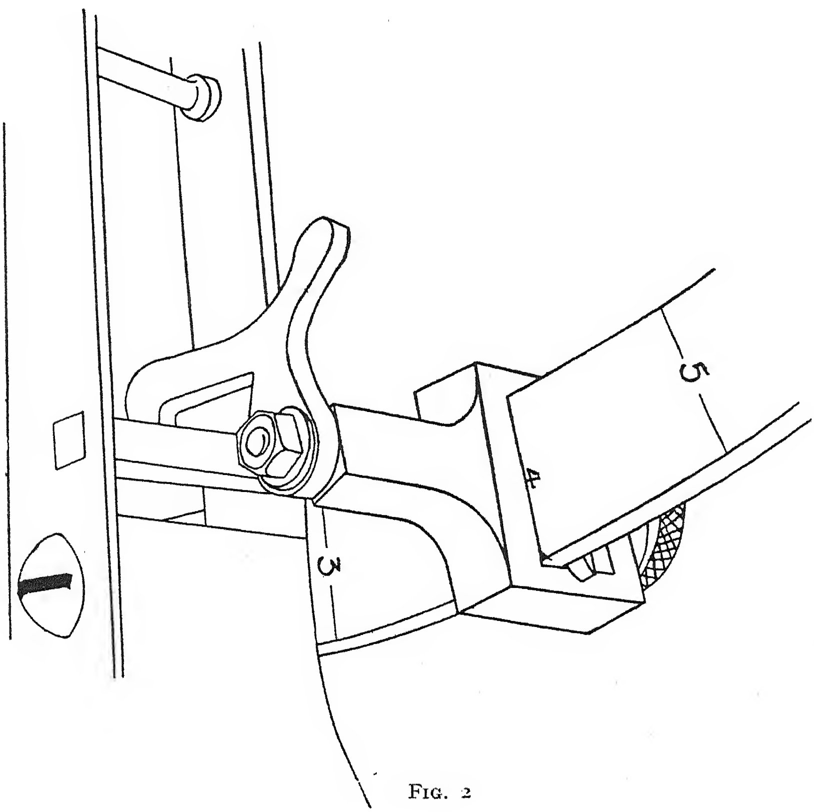

FIG. 2

to absolute units of energy.* The bob is fastened by two stout bolts so that the capacity can be varied by replacing it with a heavier solid bob or a lighter aluminium one.

Apart from questions of convenience, the essential feature of design is that no appreciable energy should be expended except in breaking the specimen. The grips and their anchorages must be rigid, so that they only yield by an amount negligible in comparison with the extension of the specimen. The frame and supports for the pendulum must also be rigid and the axle frictionless (in ball bearings). Furthermore, the pendulum must be designed to resist the impact, to minimise air resistance, and for proper balance, so that the grip can be fixed at the "centre of percussion." As in a cricket bat there is a point where the ball can hit without jarring the hands, so if the impact comes at the correct point on the pendulum, the whole weight acts as if concentrated at the grip and there is no impulsive force on the support or bending moments in the pendulum.

Before a series of tests the releasing catch is fixed so that the swing is sufficient to break comfortably the strongest specimen. A mean reading of 0·3 is sought, as this is in a sensitive part of the scale and ensures approximately the same velocity of the bob, i.e., rate of extension, at break for all tests. For testing leas, the yarn is wound on a wrap reel and the grips fixed at opposite diameters. The routine of a test consists in slipping the grips into position, pulling the releasing trigger, taking the reading, and swinging the bob back to the catch, which occupies in all perhaps five seconds, apart from the time required to fix the grips on the specimen.†

As the result of the test is the sum of the work absorbed by each thread, it should be proportional to the *number of threads* within the limits allowed by the variability of the yarn. By observation on specimens from 10 to 80 threads (Fig. 3), the work per thread was found to be constant and therefore equal to the mean work of rupture of a single thread. Among the consequences of this simple relation, the irregularity of results should decrease as the square root of the number of threads, this also being borne out by the observed figures. From lea tests on 17 varieties of cotton yarn, the mean irregularity of work was 3·46%, of breaking load or "pull" 4·56%. The ballistic test gives the more regular results, although they involve variations both of breaking load and extension, because the mean deviation of skein strength decreases very slowly, as the 1/5th power, with number of threads (*vide* Papers I. and IV.).

It is no small advantage that accurate comparison should be possible between specimens of different numbers of threads, for this is tantamount to a greatly extended range. A single or double tyre cord, a few strands of

* The C.G.S. unit is the erg or the joule (10^7 ergs) or the gramme.centimetre. The latter is most convenient for research purposes, and is the work done in raising one gramme one centimetre. The English engineering unit is the foot.pound, but for textile testing one-twelfth of this, the inch.pound, appears very suitable as it gives a figure for leas close to that given by the usual lea test, and because the extensions are of the order of an inch. The full capacity of the instrument is 80 in. lbs., or 92,170 gm. cm., that is, it will just break a specimen which will just bring to rest a weight of 80 lbs. in a fall of 1 in., or 40 lbs. in a fall of 2 inches.

† In a later model, grips are dispensed with for lea testing, the skein being hitched to a bar at either end. The complete routine is then distinctly quicker than the usual lea test. (2nd June 1926.)

sewing cotton, a lea of 50's and a double lea of 100's can be tested and compared, the total work of each being approximately the same and close to the capacity of the one instrument.

The variation of breaking load with *speed of break* is described in Paper III., and this effect may be expected to increase the work of rupture if a weak specimen is broken by the full fall of the pendulum. The results (*loc. cit.*) show a slight tendency to rise, perhaps 2% between readings at 0·2 and

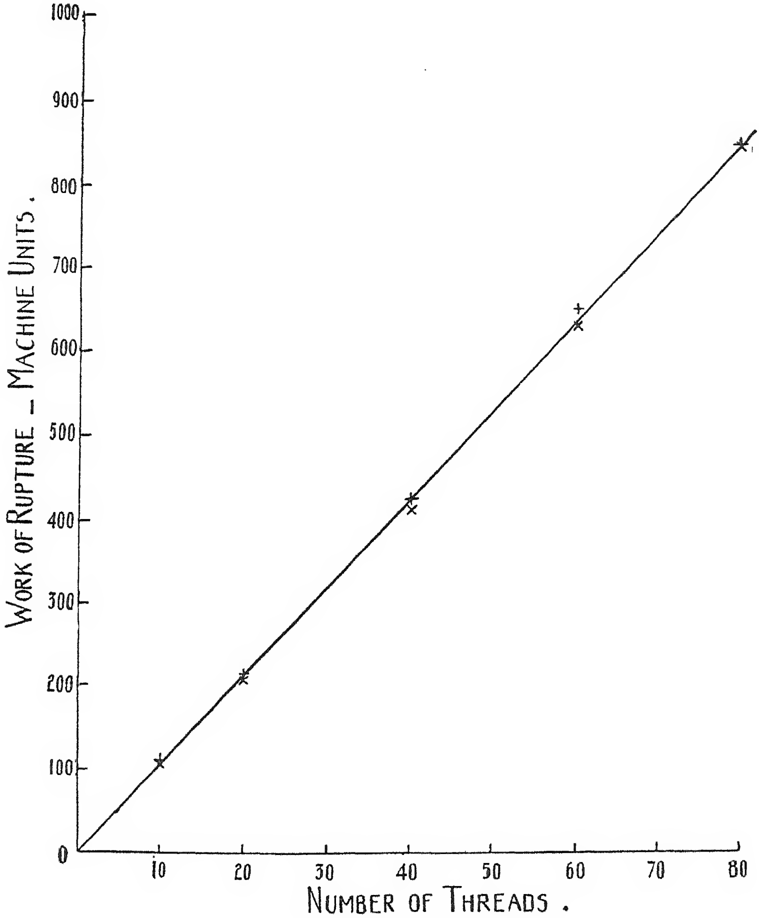

Fig. 3

0·6 on the scale graduated in fractions of the total capacity. In ordinary use the release is set to give readings always in the region of 0·3 to ensure a clean break and a sensitive scale. This also fixes the final rate of extension of the specimen, avoiding the effect of speed on breaking load, and giving the fairest comparison between materials of different strength and elasticity.

Comparison between the ballistic results and single-thread properties measured in other tests is mainly conditioned by the relation between breaking load and speed, and is made clear by a consideration of autographic load-extension curves (see below) and by the experiments described in Paper III.

The work of rupture is not exactly proportional to the *length of specimen*, but becomes so by subtracting a small constant amount. The relation is fully accounted for by the decrease in breaking load with strength owing to irregularity, as found in Paper I., together with a smaller effect due to the more rapid break of short specimens. The energy absorbed at the point of rupture in pulling the hairs apart seems too small to have a measurable effect. For routine testing the length of specimen should be kept constant for the same reason as in single-thread testing, the irregularity along the length.

While designed primarily for testing skeins of yarn as wound on a wrap-reel, the ballistic tester can be used equally well for single tapes of yarn, thus facilitating the use of the "*cut-skein sample*" method. Control tests show a striking degree of identity between sets of halves and such samples are used regularly and confidently for isolating and measuring very small effects in tendering by light or acids, &c.

The rapidity of the test allows the testing of yarns in a state which cannot be maintained for more than a few moments, e.g., bone dry. It is therefore particularly suitable for use in conjunction with the humidified box where a controlled room is not available. The specimen, previously fixed in the detachable grips, can be removed and tested before any change in moisture condition can occur.

Very regular results have been obtained on cords, tapes, strips of duck and wires, the only adaptation being a special form of grip if necessary. In a set of 12 tests on single copper wire the maximum variation was from 84 to 93 units, though the total energy absorption was not one-tenth the range of the instrument. As a routine test for artificial silks, this method avoids the long plastic flow which detracts from the value of measuring breaking load and extension at slow speeds.

The machine comprises a heavy pendulum mounted on ball bearings, with a scale and pointer to record its maximum deflection. It is therefore essentially of the same construction as a standard *lea tester*. A semi-circular pulley is fixed at the axis to strengthen the pendulum and to assist in obtaining the proper balance or position of the centre of percussion. This also serves as a pulley over which a flexible strip with a lea tester hook can be affixed in a second (Fig. 4). A winding apparatus with lower hook is permanently fixed at the end of the stand, and can be operated either by hand or motor. The results are identical with those of an ordinary lea tester.

Expressed in inch-pounds the ballistic work of a lea is usually a fraction greater than the "pull" in pounds, but the fraction is variable, as the latter is subject to the many disturbing factors not affecting the work. Its relation to single-thread breaking load depends not only on the extensibility and on the shape of the load-extension curve, but also on the effect of speed, which may vary according to the yarn. Roughly the results by the different tests are of the following relative order—Single-thread, 6 oz. (60 lbs. per lea); Moscrop, 7·5 oz. (75 lbs. per lea); lea test pull, 44 lbs.; ballistic work, 55 inch.lbs.; but they cannot be calculated one from the other.

The ballistic tester described above has been in regular use in this laboratory since the beginning of 1924, and has proved in practice a thoroughly trustworthy and convenient instrument for routine testing. A model, even more serviceable and simple in construction and operation, is at present under construction.

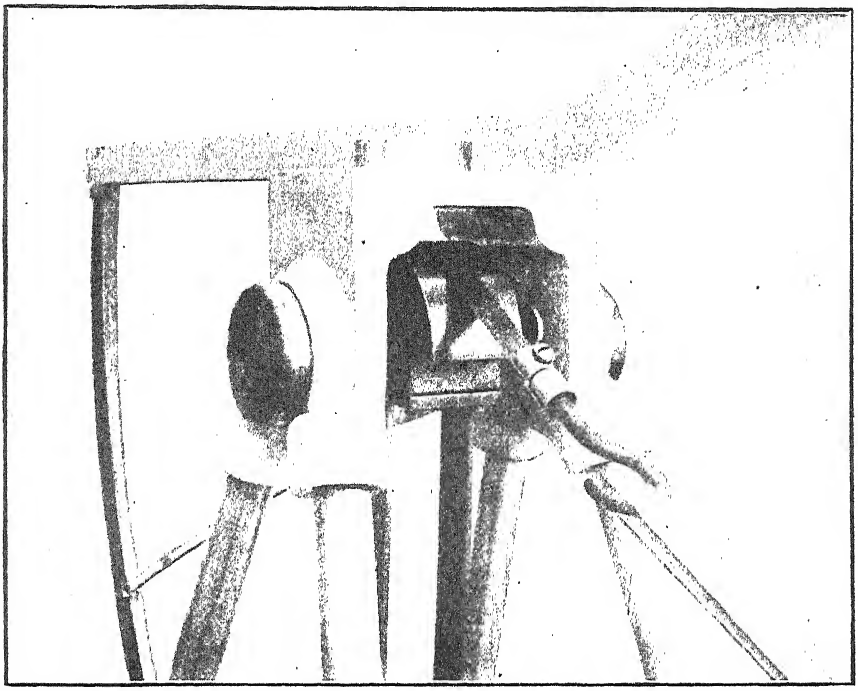

FIG. 4

Load-Extension Curves

An understanding of the quantity, work of rupture, which is measured in the ballistic test, and of the relation between this and single-thread tests, may best be obtained by a study of curves of load against extension. They also provide another method of measuring work of rupture and have great use in research, as distinct from routine testing, on unfamiliar kinds of thread, especially in conjunction with the ballistic tester.

Several instruments have been described or manufactured for tracing such curves, most of which are complex and have mechanical magnifying devices which introduce forces too large in comparison with the light load on a yarn. The simplest and soundest for yarn testing appeared to be that described by Shorter and Hall,[6] which has the great advantage of being usable at high speeds. In Fig. 5 a modification of their instrument is illustrated, designed for testing cotton yarns. The lower grip is made adjustable for lengths up to 25 in., and the record is made by a gramophone needle on a smoked glass plate. (The record of a fine pen on a polished card is not much coarser, and is quite satisfactory for most purposes.) The upper grip is fixed to the spring by a very light frame of duralumin. A steady rate of loading is obtained by attaching the carriage to the piston of a single-thread tester, but it may be driven also by hand, motor, or falling weights. Otherwise the principle of the machine and the diagrams are as described in the paper cited.

A few examples will show the use that can be made of these load-extension curves. Fig. 6a shows the trace given by a strand of nickel wire. The horizontal line is that traced when no specimen is mounted and marks

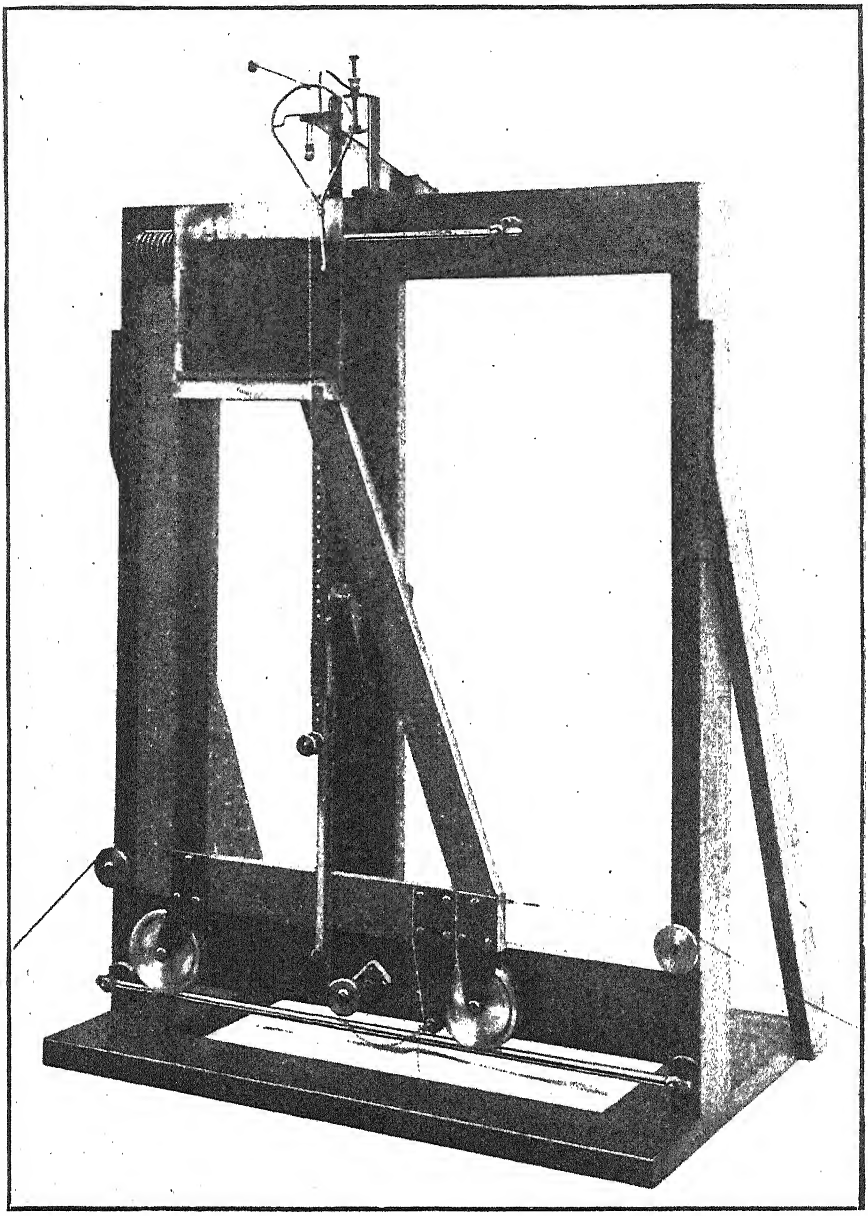

Fig. 5

the zero of tension, the line at 45° to it is traced when the grips are connected by an inextensible specimen, a metal chain, and marks the zero extension. On the trace given by the nickel wire the vertical distance from the first measures the tension, the horizontal distance from the second the extension. In Fig. 6b, the trace is redrawn so that the horizontal distance from the origin is equal to the extension, i.e., in rectangular co-ordinates. This curve is typical of most simple materials. At first the trace is straight

and the extension is proportional to the load, independent of time, and perfectly elastic. Then, at the yield point, it increases more rapidly, and in this region the specimen would extend without further load and would retain some extension if unloaded.

Fig. 7, traces given by Celanese and viscose, shows that artificial silk follows a similar course, but the latter "plastic" portion is longer, and the elasticity is not so truly perfect in the straight portion. On Fig. 8 are compared traces of 36's Sakel yarn, sized and unsized. Fig. 9 shows that of a yarn, spun to counts too high for the quality of the cotton, which broke by pure fibre slip instead of snapping like an ordinary yarn. The varying form of these curves shows how differently materials may behave under tension and the very limited information given by measurements at break alone.

The resistance of a cotton yarn to extension is shown more clearly by Fig 10. The simple trace A is that given by a 36's Sakel yarn loaded steadily to rupture, the other of a similar yarn put through a more complicated operation. At low tensions the trace is slightly concave, the resistance increasing as the twisted fibres straighten and press together. Under steady loading it then becomes straight till the thread breaks, but, as the second trace shows, this straight line does not mean truly elastic extension as in metals, but depends on the steady rate of loading. At B the carriage was held still and the thread continued to extend under a decreasing load. On releasing the tension, it was found that a large portion OC of the extension remained, part of which was permanent, whereas part was slowly recovered from, for after a few minutes rest tension began again at D. Increasing the tension steadily again, the yarn passed through its former state at B, and then behaved in the same way as the first yarn loaded steadily. At E the tension was kept constant, but the yarn continued to extend slowly and appeared to come to rest. Further tension was added and again maintained constant at F. The yarn continued to extend for about a minute, when it broke at a load much less than the breaking load of the first, but with an extension not appreciably different.

On Fig. 11 are the traces given by two threads loaded steadily, one very slowly, one quickly, the breaks occupying 100 and $\frac{1}{3}$ sec. respectively. The latter has a lower breaking load, but the final extensions are nearly the same. A change of breaking load with speed is thus a real property of the yarn, while no evidence could be found (Paper III.) of any significant change of final extension.

In Fig. 12 each little figure made by the shading is equal to the product of a portion of the extension, and the tension producing it, whilst the whole shaded area gives the work of rupture. The area increases as the speed is increased, for example, the work of rupture of a 36's Sakel yarn in gram. cms. per cm. was 9·7 at slow single-thread speeds, 12·2 at Moscrop speeds, while the faster ballistic test gave 14·7.

The work of rupture may be expressed as a constant factor multiplied by the product of breaking load and final extension. The factor is 0·5 if the trace is a straight line, and for unsized single yarns it is usually between 0·5 and 0·4. The factor for a batch under test can be obtained from 10 load-extension curves, and the work of rupture then calculated from the mean product of load and extension found on the deadweight tester. The advantage of this is that the test on the Shorter and Hall instrument is

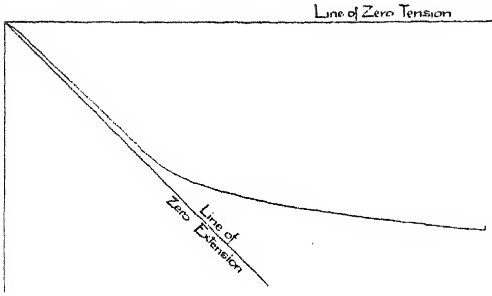

FIG. 6A

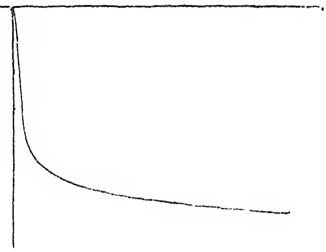

FIG. 6B

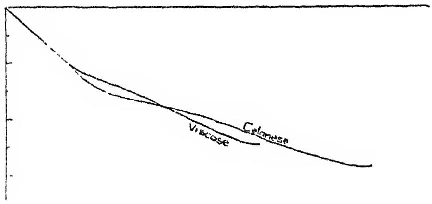

FIG. 7

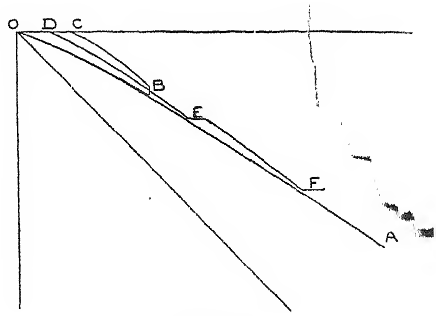

FIG. 10

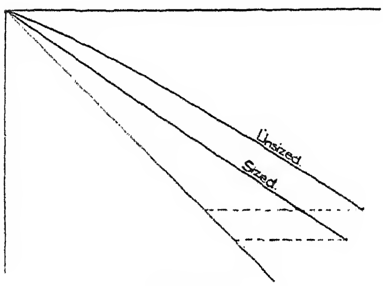

FIG. 8

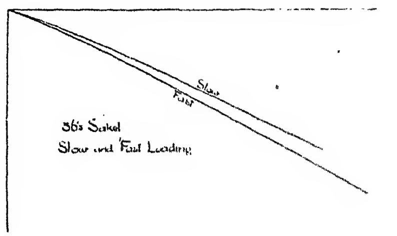

FIG. 11

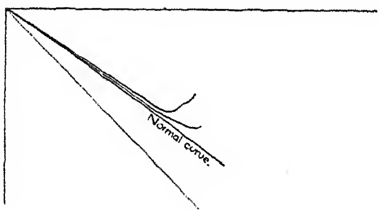

FIG. 9

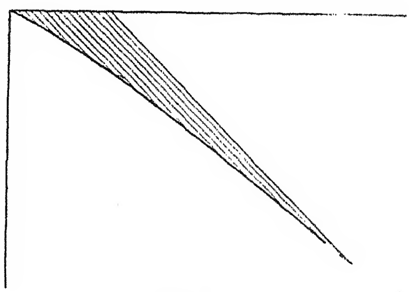

FIG. 12

slow and laborious compared even with the usual single-thread test. Autographic tests at high speeds may also be used to obtain a value for the extension and "work factor" from which to calculate the breaking load at ballistic speeds, and the several tests thus check and complement each other.

DETAILS OF EXPERIMENTS WITH THE BALLISTIC TESTER

The dynamical principles of the instrument are analysed in Paper IV.

Number of Threads

The proportionality between work of rupture and number of threads was tested on two sets of specimens of 80, 60, 40, 20 and 10 threads, with the results shown in Table I and Fig 3.

Table I.

Work of Rupture of Varying Number of Threads.

36's Sakel yarn, 26·5 inches in length. Reading in 1/1,000th of machine capacity.

No. of threads ...	80	60	40	20	10
Release	1,100	900	700	500	400
Reading—					
1st set of 20 ...	$245 \pm 5{\cdot}0$	$264 \pm 3{\cdot}3$	$283 \pm 2{\cdot}2$	$294 \pm 2{\cdot}0$	$294 \pm 0{\cdot}9$
2nd set of 20 ...	$243 \pm 3{\cdot}8$	$245 \pm 3{\cdot}5$	$273 \pm 3{\cdot}1$	$286 \pm 1{\cdot}6$	$290 \pm 0{\cdot}6$
Gm. cm. per thread—					
1st	$985 \pm 5{\cdot}8$	$977 \pm 5{\cdot}1$	$961 \pm 5{\cdot}1$	$950 \pm 9{\cdot}2$	$977 \pm 8{\cdot}3$
2nd	$987 \pm 4{\cdot}4$	$1006 \pm 5{\cdot}4$	$984 \pm 7{\cdot}1$	$986 \pm 7{\cdot}3$	$1014 \pm 5{\cdot}1$
Mean	$986 \pm 5{\cdot}2$	$992 \pm 11{\cdot}1$	$973 \pm 9{\cdot}9$	$968 \pm 14{\cdot}7$	$996 \pm 14{\cdot}4$

The work of rupture of the specimens is proportional to the number of threads, for the work per thread shows no consistent variation with number, nor are the differences of statistical significance but due to sampling variations alone.

As the result is a simple sum, its irregularity should decrease as the square root of the number of threads. The irregularity of the product of breaking load and extension was found on the 30-in. specimens of Table II., Paper I., to be for single threads, 12·4%; for the mean of 10 threads, 4·1%; and for the mean of 80 threads, 1·4%. In the above results it is for 10 threads, 4·2% and 2·6%, for 80 threads 3·0%, and 2·3%, which is as near as sets of 20 results could be expected to give.

Length of Specimen

The work of rupture will not be exactly proportional to the length of specimen for the following reasons—

(1) The breaking load decreases with length owing to irregularity, and the extension decreases in the same proportion.

(2) The time occupied in stretching to rupture increases in proportion to the length.

(3) The work absorbed in pulling the hairs apart and breaking them at the actual point of rupture is a constant addition to the energy absorbed in stretching the whole length.

All three make the work on shorter lengths proportionately greater.

The effect was measured on 11 in. and 30½ in. specimens of the 36's Sakel yarn, one of each being cut from a skein of 30 turns. The results obtained on 25 of such pairs and on 24 specimens of 24 in. length wound alternately are shown below—

Length	11 in.	30½ in.	Difference	24 in.
Gm. cm. per thread	483 ± 2	1126 ± 5	643 ± 4	917 ± 5
M.D.	13	31	26	26

These three points lie very exactly on a straight line, giving the work as a small constant amount added to an amount proportional to the length. The pairs define this relation for the work in gm. cm. per thread of length L cms., as

$$W=119{\cdot}6\ (\pm 0{\cdot}3)+L.13{\cdot}0\ (\pm 0{\cdot}1).$$

For the 24 in. length this gives 912 ± 6, which is statistically the same result as that observed, and 994 for the $26\frac{1}{2}$ in. length, in good agreement with the results on Table I.

The constant amount, 119·6, is equivalent to an extension of 4·6 cm. at the maximum tension, and if the last effect (3) were responsible for the whole amount, it would mean that a resistant extension of this order occurred at the place of rupture. The load-extension curves show that this is not the case, and it is doubtful whether any appreciable energy is absorbed at the ruptured portion, for the first two effects are sufficient to explain the greater strength of shorter lengths. From the two sets of single-thread tests on 10 in. and 30 in. lengths of this Sakel yarn (Table I., Paper I.), the correction to the product of load and extension of 30 in. lengths necessary to make it equal to that of 10 in. lengths would be 0·4% and 19·9% respectively, the theoretical amount calculated from the irregularity being 19%. From the results given in Paper III., the correction for the trebled speed should be about 3·6%. As an addition of 18·9% to the work on the $30\frac{1}{2}$ in. lengths would reduce the constant amount to zero, only a small proportion of it can have the physical significance of work absorbed at the break.

Ballistic Machine Used as a Lea Tester

The following tests were performed on alternate windings of the various yarns with a standard lea tester and the ballistic machine used as a lea tester (Fig. 13). For this use the latter is as circumscribed in range as any other deadweight instrument, and 30 turns of the stronger yarns had to be compared with 40 turns on the heavier standard tester. This can be done by multiplying by 4/3, as the difference is not great enough to introduce the complications discussed in the last paper.

Tests on 10 specimens with each Tester. Breaking loads in Pounds.

Leas of 60's West Indian yarn:—	Half-leas of 36's Egyptian ring yarn:—
Standard $44{\cdot}2\pm 0{\cdot}8$, M.D. 6·2%.	$49{\cdot}5\pm 0{\cdot}4$, M.D. 3·2%.
Ballistic $44{\cdot}1\pm 0{\cdot}4$, M.D. 3·0%.	$53{\cdot}2\pm 0{\cdot}3$, M.D. 2·9%.
Half-leas of 36's Sakel yarn:—	Half-leas of 32's Egyptian yarn:—
Standard $53{\cdot}5\pm 0{\cdot}4$, M.D. 2·7%.	$52{\cdot}2\pm 0{\cdot}4$, M.D. 3·0%.
Ballistic $55{\cdot}9\pm 0{\cdot}4$, M.D. 2·7%.	$51{\cdot}1\pm 0{\cdot}3$, M.D. 2·0%.

As is to be expected, there is no significant difference between the results. If anything, the ballistic machine gives rather less variation, which may be a real difference, as the friction is less and the pointer stops dead.

Greater range can be obtained by replacing the bob with a heavier one or by affixing weights to the stem of the pendulum. Calibration is done conveniently by hanging weights and readings converted by a graph from the ballistic scale or taken directly from a deadweight scale on the reverse side of the recording arc.

It must be remembered that the results of such a lea test are of a lower order of accuracy than those of the ballistic method, and do not give a mean value of breaking load. In particular, they cannot be used in combination with the work of rupture to find the breaking load and extensibility separately except in a very rough, comparative way.

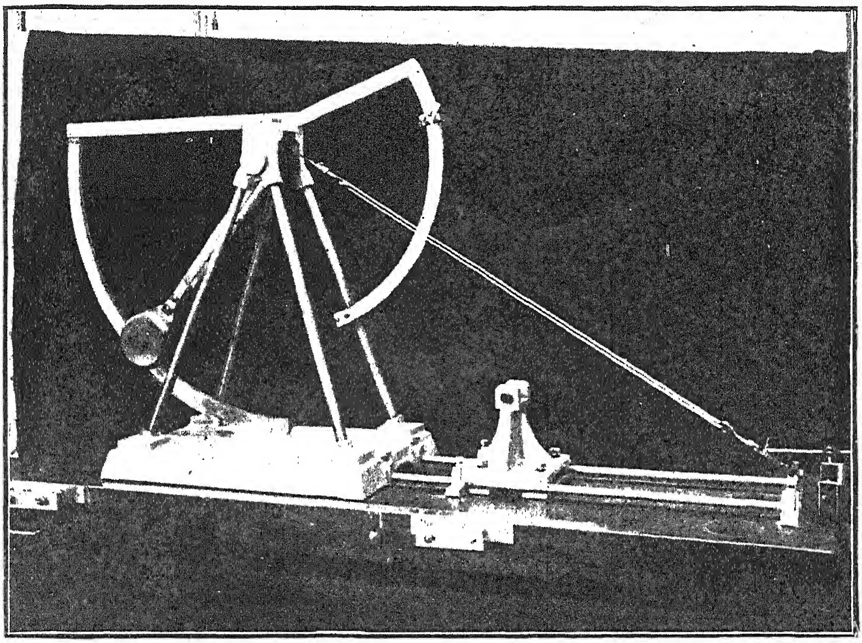

Fig. 13

Cut-Skein Samples

In a control test on 25 windings of 30 turns of 36's Sakel yarn, one set of halves gave a mean $313{\cdot}68 \pm 1{\cdot}14$ work units, the other $312{\cdot}44 \pm 1{\cdot}16$. The absolute differences between the corresponding halves were distributed thus—

Difference	0	1	2	3	4	5	6	7	8	9	10	11...15
Frequency	1	2	2	2	2	2	4	2	2	1	1	1... 3

As 15 of the 25 differences are 6 or under, the probable difference between two halves of one winding is under 2%. With specimens nearer the capacity of the instrument, 1.000 units, and more threads, the probable difference should be correspondingly diminished.

This test was done on a very regular yarn, but was repeated on one of the roughest and most irregular obtainable, a 20's waste yarn. On 50 pairs of "cut-skein samples" (30 turns), the mean of one set was $217{\cdot}62 \pm 1{\cdot}88$, of the other $217{\cdot}74 \pm 1{\cdot}99$, and half the differences were under 6, the distribution being—

Difference ...	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Frequency ...	6	5	2	4	5	3	5	3	3	4	1	3	0	2	2	1	0	1

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30—VIII.—TENSILE TESTS FOR COTTON YARNS
iii.—THE RATE OF LOADING

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INTRODUCTION AND SUMMARY

The necessity for operating a testing machine at a standard rate is generally recognised. This arises partly from instrumental errors introduced at high speeds, but when these are allowed for (*vide* Paper IV.), there is still a consistent and appreciable increase of apparent strength as the test is speeded up. In comparing the breaking loads of a yarn as measured on different instruments, the results are found to vary very greatly with the time occupied in a break. The Moscrop test, occupying about ½ second in stretching the thread to rupture, has been found to give a result usually between 20 to 30% above that of the standard single-thread test, which occupies about 20 seconds. The ballistic test breaks a specimen in about $\frac{1}{50}$th second, and the breaking load can be calculated, on assumptions which cannot be greatly in error, by dividing the work by one half the extension. The load so calculated was found on 23 different yarns to be on an average 43% above the standard load.

To measure with some precision the variation of breaking load of a yarn when only the speed of testing is altered, a very regular 36s Sakel yarn was tested on several instruments over the range of speed allowed by the mechanism, taking particular care to obtain similar samples and constant testing conditions. The apparent strength was then found to increase with the speed of the test in a definite and regular manner, the rate of change within the range of each instrument agreeing with the greater differences between the results of the several tests. The mean breaking load on the standard single-thread tester varied from 11·7 oz. to 13·0 oz. as the rate of traverse varied from 3 to 30 inches per minute. Taking the mean value when the specimen is broken in 20 seconds as 100, the breaking load given by the Moscrop tester, taking about ½ second, is 129; with a variation in time of break on the autographic instrument from 90 to 0·4 seconds, the value changes from 96 to 121; and the value calculated from the ballistic test, taking $\frac{1}{45}$th second, is 139. Further, one half the specimens broke within 2½ minutes under a load 72% of the standard value, within 92 hours under 58%, or within 18 days under 50%. Taken over all the range of speeds, the mean breaking load of the same yarn varied from 5·6 oz. to 18 oz., due solely to the change in the time occupied in the break, namely from a month to $\frac{1}{60}$th second.

These changes may be generally expressed in a very simple way, namely, that if the time of break is increased tenfold, the breaking load always

decreases by the same amount, $\frac{1}{10}$th the value given by the standard deadweight tester. Though the rate of change must become less, both for extremely slow and fast breaks, the relation remains constant over the range of practicable observation.

No change in final extension could be found on the deadweight tester, nor on the autographic instrument when the speed was altered 200-fold. It would seem that a yarn breaks because it is forced beyond a limiting extension, rather than because it is overloaded.

The relation with speed for the breaking load of a yarn is the same as that for hairs, i.e., the ratio between the breaking load of the yarn and of the hairs which compose it remains constant with speed at a value found to be 0·4 in this particular case. Moreover, there seemed no appreciable difference in type of break between ends broken ballistically or slowly. The conclusion thus indicated is that though the uniformity and clinging power of the hairs is only sufficient to make less than half the aggregate strength available, this factor does not alter with speed, and the load at rupture is determined by that of a core of tightly gripped hairs. Data[1] are quoted to show that the same effect in fabrics is of the same order of magnitude and may also be wholly or largely ascribed to the elastic properties of the hairs.[2]

As a matter of testing routine, speed is standardised by the rate of traverse of the loading jaw or by rate of loading. This eliminates mechanical errors but does not wholly eliminate the effect of speed on apparent strength, which is a function of the time occupied in the test. Results given by a strong and a weak specimen on one instrument are not strictly comparable, since the former is broken more slowly. The same specimen would appear a few per cent. stronger on a heavy instrument than on one of just sufficient range, both driven at the standard rate. Fortunately the effect is not rapid enough to demand attention in ordinary routine testing, but as the speed of testing and the resulting breaking load are arbitrary, it is preferable to approximate to the speed with which yarns are broken in practice. The greater rapidity of the ballistic test means a closer approximation to working conditions and also to the upper limit which must exist as an absolute strength characteristic of the material.

The effect should not be lost sight of when interpreting tests for wear, oscillating stress, &c., of which the results are expressed by the number of rubs or jerks survived, for a load less than half the deadweight breaking load will continuously extend the yarn towards rupture without the help of wear.

EXPERIMENTAL METHODS AND RESULTS

Each testing instrument is designed to work within a particular range of speeds, which is limited by dynamical considerations (*vide* Paper IV.) and by convenience of operation. One machine can be used only over a small portion of the total range of practicable speeds, and the variation of breaking load must be followed through several different tests.

The speeds of the several machines are controlled in different ways, and mutual comparison is facilitated by using the quantity T, "the equivalent time of the break," i.e. the time which would be occupied in loading the specimen to rupture at the rate of loading obtaining just before rupture. The formulæ for the values of T used below are worked out in the following

paper. It will be shown at a later stage that the breaking load (F) is most simply expressed as a function of log T, and the curve will be defined by evaluating for the small range covered by each instrument the slope ($dF/d \log T$), and the mean values of F and log T.

The tests were all carried out in a room maintained at 70° F. and 70% R.H. on a very regular 36s Sakel yarn. Wherever possible, comparisons were made by the "cut-skein sample" method (Paper I., p. 78), or on consecutive windings from the same cop.

Standard Single-Thread Deadweight Tester

The instrument used is driven by an oil plunger, thus avoiding the initial jerk and consequent oscillation (*vide* Paper IV.). The pendulum has a very short time of vibration (1·0 sec.), reducing momentum errors to a minimum, and the tester may safely be used over the range which can be obtained from the plunger. The speed is controlled by the fall of the lower jaw, the normal being 12 inches per minute, and tests were made in pairs at speeds from 3 to 30 inches per minute on sets of 50 alternate threads of 20 inches length.

The speed of fall, the time of break (from Equation 10b, Paper IV.), and the corresponding mean values of breaking load and extension for the seven pairs of tests carried out are shown in Table I. The probable error of the difference between any two values of breaking load, considering the samples as independent, is 4·0 grams, and a difference of less than 12 grams is hardly significant. Taken as a whole, the values show a regular and significant increase with speed. Those from pair No. 5, however, are far off the general range and give the only case of a decrease. As the sample is exceptional, the values are ignored in taking the general means. (The deviations of the breaking loads of this pair from the best straight line through the remainder are six times the probable deviation calculated from the other twelve values.)

Between the members of the pairs, the differences have a higher significance and are very consistent. Expressed against log T the mean slope of the six tests is 29·3 ± 5·1 grams; weighted according to the difference in log T, the mean is 25·7 grams. The slope given by the slowest (1a) and fastest (7b) breaks is 34·2 grams, and the median slope between the pairs is 30·4 grams, perhaps the best value as most independent of the method of expression. The best straight line drawn through the array of points by the method of least squares gives a slope 34·5 grams. (The correlation coefficient between F and log T is 0·84, and the probable variation of the slope is about 3·4 grams.)

There is no correlation between the extension and the speed among the independent samples. (The actual correlation coefficient between e and log T is + 0·067, which is not significant.) The differences within pairs show no regularity either of magnitude or sign, nor are they big enough to be statistically significant, but appear to be purely random variations of testing and sampling.

For the purposes of the general relation, the results on this machine will be expressed by a slope—

$$\frac{-dF}{d \log T} = 30{\cdot}4 \text{ grams from } \log T = 0{\cdot}94 \text{ to } 1{\cdot}91,$$

through the point ($\log T = 1{\cdot}33$, $F = 347$ grams), the extension remaining constant at 6·48 ± ·03%.

Table I.

Single-Thread Deadweight Tester

Traverse inches per min.	Time T sec.	Breaking Load F gm. $\pm$ 2·8	Extension % $e\%$ $\pm$ 0·06	$-\Delta F$	$\Delta \log T$	Δe	$\dfrac{-\Delta F^*}{\Delta \log T}$
1 { 3	81·7	334·6	6·64	20·9		—·01	
12	21·3	355·5	6·65		·584		35·8
2 { 3	80·0	332·8	6·26	15·1		+·20	
25	9·8	347·9	6·06		·912		16·6
3 { 6	40·5	335·7	6·40	14·1		—·08	
18	13·9	349·8	6·48		·465		30·4
4 { 6	40·1	331·7	6·46	14·0		—·13	
18	13·9	345·7	6·59		·460		30·4
5 { 12	19·1	324·5	5·81	–1·4		—·29	
21	11·9	323·1	6·10		·206		–6·8
6 { 12	21·0	349·2	6·61	1·3		+·17	
24	10·3	350·5	6·44		·309		4·2
7 { 21	12·2	359·3	6·50	8·6		—·03	
30	8·7	367·9	6·53		·147		58·5
Grand Mean excluding 5 log T = 1·33		346·7	6·48$\pm$·03	12·3	0·480	+·017	29·3$\pm$5·1

* $\dfrac{dF}{d \log T}$ is the symbol for the tangent or slope at a point on the curve.

$\dfrac{\Delta F}{\Delta \log T}$ is the symbol for the slope between two points separated by an appreciable distance.

Moscrop Tester

The breaking load can be measured at much greater speeds on the Moscrop tester, to the limit of speed imposed by the errors discussed in Paper IV. The speed is controlled by the number of complete cycles per minute, eight being normal. The equivalent time of break is given by Equation 27, Paper IV., in terms of velocity of the loading jaw ($\dot{x}$), which in the present work, with breaks occurring at the middle of the 32 oz. record, is 1·306 p, whence $T = 0{\cdot}217\ F/p$.

The correction for the fling of the pointer is also evaluated as 0·00406 p^2 oz., and is thus allowed for in Table II., where results of tests from 3·6 to 25 cycles per minute are given. The first seven tests were carried out in one day in immediate succession, 75 specimens on each of six cops at each speed, this being the nearest approach to alternate thread sampling for this machine.

The dynamical analysis and tests given in Paper IV. show that the speeds 25 and 22·5 cycles per minute are too high, and the corresponding low results are due to injury from the jerks of the recording slide. At the speed 18·1, the frequency curve of the breaks (Fig. 3, Paper IV.) shows that this error is beginning to affect the results, and though they are not seriously wrong from the standpoint of routine testing, the mean for this speed is best omitted in evaluating the fine effect under discussion.

Within the limits of sound testing speed, the results of Table II. show an increase with speed but also considerable sampling differences. To obtain a general mean most free from instrumental and sampling errors, the sum of the differences was found between 1—3 and 6—7, and the ratio of the total change in F to the total change in log T gives a slope $-dF/d\log T =$ 24·2 from $\log T = \bar{1}\cdot97$ to $\bar{1}\cdot39$ through the point ($\log T = \bar{1}\cdot66$, $F = 447$ grams).

Table II.

Moscrop Single Thread Tester

p Cycles per minute	Time T sec.	Breaking Load* oz. ± ·05	Correction $0\cdot00406\, p^2$	Breaking Load, Grams, corrected	$\dfrac{-\Delta F}{\Delta \log T}$
(1) 3·6	0·94	15·68	0·05	443	(1) — (3)
(2) 6·0	0·57	15·90	0·15	447	10/0·542 = 18·5
(3) 13·0	0·27	16·67	0·69	453	
(4) 22·5	0·13	15·73	2·06	388	
(5) 18·1	0·19	17·25	1·33	451	(6) — (7)
(6) 14·2	0·24	16·75	0·81	452	12/0·368 = 32·6
(7) 6·0	0·56	15·67	0·15	440	
(8) 3·5	0·98	15·86	0·05	448	
(9) 25·0	0·12	16·36	2·54	392	

* Each figure is the mean of 450 single tests.

Shorter and Hall Autographic Load-Extension Instrument

The autographic instrument is reliable over a wide range of speeds if the time of vibration of the spring be kept small in comparison with the time of break. It was therefore used to obtain a direct comparison between the breaking loads at deadweight and Moscrop speeds on alternate threads and a measure of the change of final extension for a large difference in log T.

Tests were carried out on two sets of 48 alternate threads 64·5 cm. long. For the slow speed, the carriage was traversed by connecting it to the oil plunger of the deadweight tester adjusted to a fall of 3 inches per minute, each test occupying on the average 90 seconds. The other set was tested by traversing the carriage by hand at the highest speed consistent with steady movement, the break occupying about 0·4 second. An initial tension of 10 grams was applied to make the extension measurements more exactly comparable.

Table III.

	Fast Loading $T = 0\cdot4$ seconds.		Slow Loading $T = 90$ seconds.
Breaking load	418 ± 2·8	... ...	332 ± 2·4 grams.
Standard deviation	σ 28 = 6·7%	... ...	30 = 9·0%
Extension %	6·637 ± 0·043	... ...	6·645 ± 0·056
	σ 0·446 = 6·7%	... ...	0·556 = 8·4%
Load/extension	61·6 ± 0·3	... ...	48·4 ± 0·3 gms. for 1% extension.
	σ 3·0 = 4·9%	... ...	3·2 = 6·5%

$$\frac{-\Delta F}{\Delta \log T} = \frac{86}{2\cdot35} = 36\cdot6$$

The breaking load at the lower speed is in the same range as those obtained on the single thread tester, but at the high speed it is 29 grams lower than

the Moscrop result. While the latter may have been obtained on a stronger sample of yarn, it is nevertheless in accordance with other Moscrop tests made on the Sakel yarn, and the difference is probably or largely instrumental error.

In the extension measurements, the difference of 0·008% of the length is quite insignificant, and in view of the great difference in speed, may be taken as evidence that the final extension is independent of the speed of testing and is the determining factor of rupture. The extension found on the deadweight tester is not significantly different from that found on the autographic tester.

The shape of the load-extension curve allows a measure of the work of rupture, most conveniently obtained by the "work factor" (Paper II.). The initial tension of 10 grams takes out much of the very unresisting extension which produces the curve at the beginning of load-extension diagrams of yarn, without doing appreciable work, thus raising the work factor to little below 0·5. The figure cannot be measured with the same degree of accuracy as the final load and extension, and little error is introduced by taking the work of rupture as one half the product of breaking load and extension.

Ballistic Tester

Much quicker breaks can be made on the ballistic tester than on any machine depending on a static principle of measurement, but the result is in energy units. Assuming that the extension remains constant at 6·64%, the value given by the autographic tester, and that the work factor is 0·5, the breaking load—

$$F = \frac{100\, w}{3{\cdot}32} = 30{\cdot}1\ w \text{ grams.}$$

where w is the work of rupture in gram.cm. per cm. Possibly about 5% of the work of rupture is due to work done after the maximum load is attained (Paper II.), but the work factor may also be about 5% less than 0·5, the two errors affecting the calculation in opposite ways. The equivalent time of break for the ballistic test is calculated from Equation 37, Paper IV. As the rate of extension decreases during the break, this is not exactly comparable with the time taken in a test at constant rate of loading, and the resulting value of log T is rather an upper limit of approximation to the best value for the general relation.

Ballistic tests were done on cut-skein samples, the alternate threads of which were tested on the standard tester at the speed 3 inches per minute, with the results—

Ballistic Test—10 specimens of 30 threads, 16 inches long. Mean reading, 379 units, $w = 16{\cdot}41 \pm 0{\cdot}10$ grams.

$T = 0{\cdot}01$ sec. $F = 494$ grams.

Single Thread—283 specimens, 15·8 inches long.

$T = 76$ sec. $F = 353{\cdot}8 \pm 1{\cdot}1$ grams.

$$-\frac{\Delta F}{\Delta \log T} = 140/3{\cdot}68 = 38{\cdot}0 \text{ grams.}$$

Within the range of the ballistic tester, the speed may be varied in two ways, by breaking similar specimens with different heights of fall or by breaking different numbers of threads with the same fall.

Table IV.

Similar Specimens Broken by Bob Released from Varying Height. 54 Specimens of 30 Threads, 24 in. long, tested at each height

Release Machine Units	Reading Units	T seconds	w grams	F grams
500	192	·034	15·5	467
700	385	·024	15·8	477
900	592	·019	15·5	467
1100	780	·017	16·1	485

Table V.

Varying Number of Threads—Constant Height of Fall, 1,100 units. 20 Specimens of each size, 67·4 cm. long.

No. of threads	80	60	40	20	10
Reading—1st 10	173 ± 9·7	409 ± 7·8	624 ± 8·8	862 ± 2·3	975 ± 1·3
,, 2nd 10	187 ± 4·2	403 ± 6·5	638 ± 2·8	862 ± 2·3	977 ± 1·8
w grams	15·72	15·82	16·03	16·28	16·95
F grams	474	476	483	490	511
T sec.	·038	·026	·021	·018	·016

The figures show a definite trend upwards with speed, but the change is too small to be estimated accurately. For instance, the apparently large difference between the results on 10 and 80 threads is produced by nine units in the reading for the former test. The highest accuracy cannot be obtained when comparisons are made between different settings of the machine, as in Table IV., or when only a small fraction of the energy of the bob is absorbed. The most accurate difference is probably that between 80 and 40 threads in Table V., which gives a slope $-\Delta F/\Delta \log T = 34{\cdot}6$. The line of least squares drawn through the nine points in these tables fixes the slope as $-dF/d \log T = 62$, from $\log T = \bar{2}{\cdot}58$ to $\bar{2}{\cdot}20$ through the point ($\log T = \bar{2}{\cdot}35$, $F = 481$), but the quantitative accuracy of the slope is low.

Rupture Under a Constant Load

Numerous observations of breaking load under steadily increasing tension cannot be carried out conveniently at rates much lower than that at which one break takes 90 seconds on the deadweight tester. The decrease of breaking load for very much slower breaks can, however, be followed by the simple device of hanging weights from a set of threads which are left undisturbed till rupture, even though that may not occur for a month.

Sets of 250, 200, 175, and 150 grams were hung from threads of the 36s Sakel yarn in a humidified box (Paper I.) which maintained the conditions of 66% R.H. and 70° F. night and day, and the time was noted when each thread was found broken. Of 70 specimens loaded with 250 grams the first broke in 1 minute, the last in 23 hours; of 38 loaded with 175 grams, the first broke in 46 hours and 13 were still unbroken after 800 hours.

The apparently irregular and divergent range of duration of the individual threads does not appear at first sight to lead to any simple relation between rate of break and breaking load. The scatter, however, is purely a question of the method of expressing the time factor; for example, if this were expressed by the mean rate of extension, the later breaks would be crowded together instead of being widely scattered. The results can be made comparable with those of the standard test, independently of the method of expressing the time, by a simple assumption, namely, that if a set of threads

be tested under a slowly increasing tension or alternatively under a constant load which they can sustain for some time, the threads will break in approximately the same order. This need not hold strictly for each thread, but rather for frequency groups; in particular, the threads which would break at the middle of the range will be the same in each case. Thus in the results given in Table VI. half the threads have broken when the increasing tension attains 350 grams in the slow standard test, half have broken in 150 minutes under a constant load of 250 grams. Then, on the above assumption, if the breaking load of a thread be 350 grams when T is 80 seconds, it is 250 grams for a duration of 150 minutes under constant load.

There is this difference between the two methods, that in the first the average load during the whole time is half the breaking load, in the second the full breaking load. This does not affect the mutual comparison of results obtained by the latter method, but comparison with the former method is improved if the time of survival be doubled to give the value of T.

The transformation of the time distribution to strength distribution was made by using the strength frequency curve at the slowest speed on the single thread tester, at which 100 specimens had been tested before winding the yarn for the hanging weight test, and 283 specimens were tested after. The latter were used in a comparison with the ballistic test, giving close sampling between the extreme limits of speed.

For uniformity of expression, all the breaking loads (F in Table VI.) are given as those of the median threads by assuming that the loads for the different quartiles bear the same ratio to each other as in the slow standard test; for example, if the weakest thread breaks at 280 grams in the latter test and in one minute under 250 grams, then the median thread breaking at 350 grams will break in one minute under

$$\frac{350}{280} \times 250 = 312 \text{ grams.}$$

The plot of the results in Fig. 1 shows that the overlapping of the figures for the several loads is so consistent that this proportionality is justified.

Table VI.

Standard Tester No. of Tests 383			250 grams 70		200 grams 18		175 grams 38		150 grams 19	
Up to	% Broken		Time mins.	F	Time hrs.	F	Time hrs.	F	Time hrs.	F
280 gms.	2	1st break ...	1	312	4	250	46	218	120	187
330 ,,	25	1st quartile	33	265	36	212	200	186	800	159
350 ,,	50	Median ...	150	250	92	200	428	175	?	150
370 ,,	75	3rd quartile	350	236	202	189	800	166		
410 ,,	98	Last break	1400	213	610	171	?	149		

Within this very extended range there is still no definite sign of curvature and the best straight line through the points given by the medians and quartiles, weighted in proportion to the square root of the number of observations, is given by the slope $-dF/d \log T = 31{\cdot}2$ grams from $\log T = 3{\cdot}60$ to $6{\cdot}49$ through the point ($\log T = 5{\cdot}15$, $F = 220$).

A further test on 59 specimens under 250 grams was made on an independent sample, the results of which are shown by the dotted line in Fig. 1. It agrees with the first test as nearly as should be expected, allowing for sampling differences.

Beyond extending the relation to much greater durations, this constant load test gives a direct criterion for the method of expressing the time factor. The threads of a sample vary in such a way as to give an approximately normal or symmetrical distribution to most measurable characters.

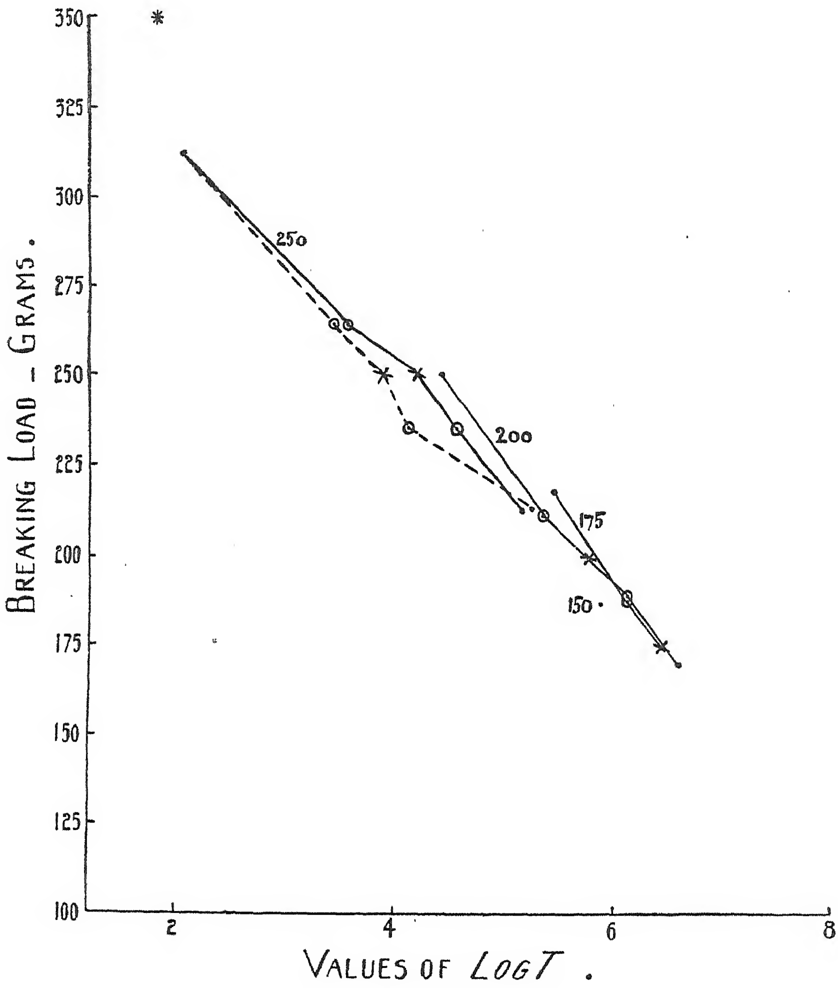

FIG. 1

Thus for breaking load, the mean, median, and most frequent values are nearly identical, the quartile deviation and maximum deviation nearly the same on either side of the median. When the load is kept constant and the strength is measured by the time of survival, the latter should be expressed by a function of which the mean value will also be approximately the median, at the middle of a symmetrical distribution.

There are several plausible methods of expression, the time T, $1/T$ which is proportional to the mean rate of extension and roughly to the rate of loading, and log T. The last has no *à priori* justification, but was found to give the simplest relation for the change of breaking load.

Table VII.
Values at Quartiles of T, $1/T$, and log T.

	Standard Test		Under 250 grams Load					
	F grams	Difference	T sec.	Difference	$1/T \times 10^5$	Difference	Log T	Difference
1st break ...	280		60		1667		1·78	
		50		1380		1616		1·52
1st quartile ...	330		1,980		51		3·30	
		20		7020		40		0·65
Median ...	350		9,000		11		3·95	
		20		12,000		6		0·37
3rd quartile	370		21,000		5		4·32	
		40		63,000		4		0·60
Last break ...	410		84,000		1		4·92	

From Table VII. it is plain that T and $1/T$ cannot be treated as quantities expressing strength, of which the mean value would represent a sample, but that log T might be used in such a way without very great error, though there is still a distinct skewness. The advantage of log T is also made clear by an examination of the results of the second test on 59 specimens, of which the mean value of the time T differs from the median by $+$ 1·62 times half the difference between the 1st and 3rd quartiles. For $1/T$ the ratio is $-$ 2·64, but for the function log T it is only $-$ 0·22. These ratios are roughly proportional to the skewness of the frequency distributions.

The Relation Between Breaking Load and Time

If the breaking load be expressed against the time from the beginning of loading to rupture, the curve is very concave to the abscissa, if against rate of loading it is very convex. It was found that the change could be expressed most simply against the logarithm of the time and the data obtained for a general relation between F and log T are collected in Table VIII. and shown graphically in Fig. 2.

Table VIII.
Collected Data on Relation between F and log T

Method	Range of log T	Mean Point F gm.	Mean Point log T	Slope $-\,dF/d$ log T
(1) Hanging weight ...	6·49 — 3·60 ...	220	5·15 ...	31·2
(2) Standard tester ...	1·91 — 0·94 ...	347	1·33 ...	30·4
(3) Autographic tester ...	1·95 — $\bar{1}$·60 ...	332	1·95 ...	—
		418	$\bar{1}$·60 ...	36·6
(4) Moscrop tester... ...	$\bar{1}$·97 — $\bar{1}$·39 ...	447	$\bar{1}$·66 ...	24·2
(5) Ballistic tester ...	$\bar{2}$·58 — $\bar{2}$·20 ...	481	$\bar{2}$·35 ...	62
(6) Standard to Ballistic ...	1·88 — $\bar{2}$·20 ...	354	1·88 ...	—
		494	$\bar{2}$·20 ...	38·0
			Mean ...	37·1

Total Range of log T, 6·5 — $\bar{2}$·2, of F, 177 — 494 grms.

To a first approximation these results give a simple linear relation. The best straight line (judged) through the whole range is shown in Fig. 2 and it has a slope $-\,dF/d$ log $T = 37{\cdot}4 = 0{\cdot}10F_1$, where F_1 is the breaking load for a time of 10 seconds. From this line the absolute values deviate no more than might be expected from sampling differences. To the mean slope the local slopes approximate according to the accuracy of determination. That given by the standard tester differs only by the manner of

finding the general mean from the individual tests. The slopes obtained by methods 4 and 5 have little quantitative significance, and the individual values of which they are the mean include values very close to 37.

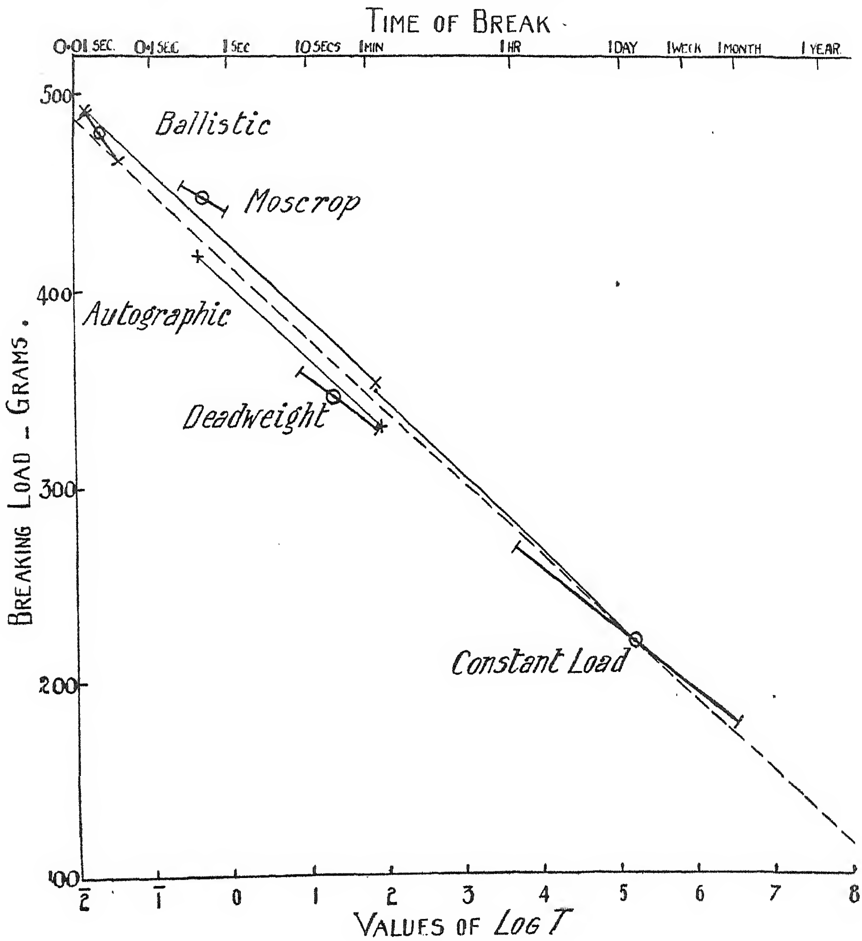

FIG. 2

In another paper[2] this logarithmic expression is related to other effects of elastic imperfection, and it is shown that limiting values must be reached at either end of the curve, but these do not seem to be approached within the limits of time covered by the present experiments. The slope from Method 1 is determined with considerable accuracy, and it may be really lower than the general slope. The fact that only one thread broke under a load of 150 grams in a month seems to point to a flattening out of the curve.

The logarithmic expression, however, covers the practicable range of experimentation with all the accuracy justified by the data or demanded for purposes of interpolation, &c., if not for theories on the physical cause.

The time effect has also been studied on the breaking load of single hairs of a Sakel cotton very similar to that which composes this yarn. It is surely significant that the identical formula $-dF/d\log T = 0{\cdot}1F_1$ applies

equally to the hairs and the yarn, in other words, that the ratio of yarn to hair breaking load remains constant, independent of the speed of testing.

The following measurements were made on the yarn and constituent hairs—

Yarn weight $= 1{\cdot}72 \times 10^{-4}$ gram per cm.
Hair weight $= 1{\cdot}39 \times 10^{-6}$ gram per cm.
$\therefore$ Average number of hairs per section $= 123{\cdot}4$.
Hair breaking load $= 5{\cdot}97$ gm. at a rate of loading $0{\cdot}5$ gm. per sec., i.e. $\log T = 1{\cdot}077$.
$\therefore$ Aggregate breaking load of hairs $= 737$ gm.
Yarn breaking load ($\log T = 1{\cdot}077$) $= 373$ gm. $= 0{\cdot}402 \times$ aggregate breaking load of hairs.

To interpret this ratio in terms of the properties of the hairs and yarn is a very complex question. It must be less than unity; first, because the hairs are oblique to the length of the yarn, so that the aggregate tension on the hairs is greater than that on the yarn; second, because the tensions and tensile properties of the hairs are not uniform (*vide* Paper V). These features of structure are not affected to any great extent by the rate of loading, and the effect of this will depend on the relative importance of fibre slip and rupture in determining the breaking load. It is possible that loosening of the least tightly held fibres proceeds during extension, throwing the load more and more on to the strongly gripped core till it ruptures. Examination of breaks under the microscope shows that rather more than half the hairs are snapped and no appreciable difference in type of break could be noticed between ends ruptured in the ballistic and hanging weight tests.

Comparisons have been made at the Manchester Chamber of Commerce Testing House[1] on the strength of fabrics as given by machines working at various speeds, and these also show a general increase of breaking load as the speed is increased. The most thorough is a test on cotton duck, alternate warp specimens being broken on an Avery and a Goodbrand machine. The first two sets, each with 500 tests on each machine, were carried out at the usual rates on specimens 2 in. wide. the times of break being 85 and 8 seconds respectively. For the third set, with 100 tests on each machine, the specimens were 1 in. wide and the rates adjusted to make the times of break equal, about 12 seconds. The results are given in Table IX.

Table IX.

	1st Set	2nd Set	3rd Set
Avery	426·5 ...	386·7 ...	252·1 lbs.
Goodbrand	454·3 ...	398·9 ...	237·5 ,,
Difference	−27·8 ...	−12·2 ...	+14·6 ,,

To make the relation between breaking load and time of break the same as for hairs and yarns, the difference in the first two sets due to speed should be about 40 lbs. Taking into consideration the difference shown by the machines working at the same rate, it appears to be of this order. Further, the extensibility did not differ appreciably in these tests.

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31—IX.—TENSILE TESTS FOR COTTON YARNS
iv.—THE DYNAMICS OF SOME TESTING INSTRUMENTS

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INTRODUCTION AND SUMMARY

The operation of several testing instruments is analysed in order to detect possible errors due to momentum or friction, to find the degree of constancy attained in rate of loading and in sensitivity, to evaluate the time of break, and to show the possibilities of improvement in any of these respects. The treatment is mathematical throughout, practical applications being detailed in the earlier papers of this series.

Momentum errors do not attain serious proportions in the pendulum type of machine, especially when the lower jaw begins to move gradually as the specimen comes under tension—a condition realised in the single-thread tester operated by an oil plunger—and when the period of free swing of the pendulum is short. The effect of an eccentric roller on sensitivity, steadiness of movement and constancy of rate of loading is examined, and it is shown that an eccentricity one half the radius[1] greatly improves the efficiency of the instrument.

The variable velocity of the loading jaw of the Moscrop machine introduces slight momentum errors, which are not important at speeds which obviate more serious dangers, and a negligible variation of the rate of loading. An error is introduced by the fling of the pointer, which increases rapidly as the operation is accelerated but which can be measured. The jerk caused by starting the slide of the recording jaw into sudden movement may seriously affect the result and cannot be allowed for in a correction. The danger is avoided by slowing the machine down to 6 cycles per minute for strong yarns, or still more for very weak ones, using springs such that the specimens break in the second half of the record. Formulæ are given for the correction for fling and for a criterion of safe speed.

The load-extension instrument is free from error if the carriage be moved steadily and suitable dimensions of the spring chosen according to the analysis given by Shorter and Hall.[3]

Calculations are given for designing a ballistic tester to avoid impulsive reactions on the support and in the pendulum, for calibration in absolute units and for evaluating the rate and time of break.

PENDULUM TESTERS

The pendulum of a single-thread or lea tester of the standard type has an appreciable inertia and if its motion be not steady, the force on the yarn differs by the effective force of the acceleration from that given by static calibration.

In particular, if the lower grip be moving when the specimen comes under tension, the pendulum starts with a jerk, producing an oscillation which is imposed on the steady increase of load. Shorter[2] has evaluated

this error for the case where the lower grip is moving at full speed when the tension begins, and the specimen is perfectly elastic. This case is reproduced in practice if a fine copper wire be placed slackly between the jaws of a single-thread tester, and the oscillations are then very evident to eye and ear. With cotton yarn, however, such oscillations damp out very quickly, only three periods being detectable whether from the initial jerk or if restarted by momentarily checking the pendulum. The single-thread machine used in the present work is operated by a plunger in oil, which starts into movement as the tension begins, so that the initial jerk is quite negligible.

Shorter[1] also suggests an eccentric roller to obtain an even scale. As the very uneven scale of the concentric roller so restricts the range, the makers (Messrs. Goodbrand), at request, incorporated this modification in the single-thread tester used for this research. Incidentally a pendulum was thus obtained with a very short free period, 1·0 second, which further reduces the possibility of error from oscillations even with more elastic specimens. A vibration of a fraction of a second can be detected with sized yarns but dies out very early.

It is desirable that three quantities should be constant over the range of a tester, closeness of scale or sensitivity, momentum of the pendulum, and rate of loading. Constancy in all cannot be attained with the dead-weight principle, so it is necessary to inquire how close an approximation can be made, quite appreciable variations being allowable before the soundness of the test is impaired.

Let the radius of the roller be r, the axis be at a distance x from the centre, and the line joining them be horizontal when the tension is zero. If θ be the inclination of the pendulum from the zero position, the vertical movement of the upper grip (positive downwards) is given by—

$$y_2 = r(\theta + \lambda \sin \theta) \text{ where } \lambda = x/r. \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

If the lower grip moves at a constant rate, its movement is given by—

$$y_1 = vt. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

As the lateral movement of the upper grip does not appreciably increase the distance between the two grips for a long specimen, the extension of the yarn is—

$$y_1 - y_2 = f/E \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

where f is the tension on the yarn and E a constant when the load-extension curve is a straight line, which is usually nearly enough the case for yarn under steady loading.

The tension according to static calibration is—

$$f - I \cdot \frac{\delta^2 \theta}{\delta t^2} \cdot \frac{1}{r(1 + \lambda \cos \theta)} = Mgh \cdot \frac{\sin \theta}{r(1 + \lambda \cos \theta)} = R \frac{\sin \theta}{(1 + \lambda \cos \theta)} \quad (4)$$

where $R = Mgh/r$ is the maximum scale reading ($\theta = 90°$), M is the mass, I the moment of inertia, and h the distance from the axis to the centre of gravity of the pendulum. As oscillations damp out so quickly and the only cases of interest are where the movement is very nearly steady, no appreciable error is caused by neglecting the term in $\delta^2\theta/\delta t^2$ to obtain, from Equations 1, 2, 3, and 4—

$$vt = r(\theta + \lambda \sin \theta) + \frac{R}{E} \cdot \frac{\sin \theta}{1 + \lambda \cos \theta} \quad . \quad . \quad . \quad (5)$$

Then the three quantities which ideally should be constant are—

Closeness of scale, $\dfrac{\delta f}{\delta \theta} = R \cdot \dfrac{\lambda + \cos\theta}{(1 + \lambda\cos\theta)^2}$ . . . . (6)

Movement of pendulum, $\dfrac{\delta\theta}{\delta t} = \dfrac{v}{r(1 + \lambda\cos\theta)} \cdot \left[1 + \dfrac{R}{Er} \cdot \dfrac{\lambda + \cos\theta}{(1 + \lambda\cos\theta)^3}\right]^{-1}$ (7)

Rate of loading, $\dfrac{\delta f}{\delta t} = vR \cdot \dfrac{\lambda + \cos\theta}{r(1 + \lambda\cos\theta)^3} \cdot \left[1 + \dfrac{R}{Er} \cdot \dfrac{\lambda + \cos\theta}{(1 + \lambda\cos\theta)^3}\right]^{-1}$ (8)

The possible error due to effective force can be judged more directly from

$$I \cdot \frac{\delta^2\theta}{\delta t^2}$$

where I can be found from the period of free swing of the pendulum T, as

$$I = Mgh \cdot \frac{T^2}{4\pi^2} = Rr \cdot \frac{T^2}{4\pi^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(9a)}$$

and

$$\frac{\delta^2\theta}{\delta t^2} = \frac{v^2}{r^2} \cdot \frac{\lambda\sin\theta}{(1 + \lambda\cos\theta)^3} \cdot \left[1 + \frac{R}{Er} \cdot \frac{1/\lambda\sin\theta + \sin\theta \,.\, \cos\theta - 2\cos\theta - 2\lambda}{(1 + \lambda\cos\theta)^3}\right]$$
$$\times \left[1 + \frac{R}{Er} \cdot \frac{\lambda + \cos\theta}{(1 + \lambda\cos\theta)^3}\right]^{-3} \quad . \quad . \quad . \quad . \quad . \quad . \quad \text{(9)}$$

It may be seen from these equations that none of the three quantities is strictly constant for any value of λ. With a concentric roller, $\lambda = 0$, the scale opens out rapidly at higher angles, the rate of loading decreases, and the rate of movement increases slightly according to the extensibility of the specimen. If the scale is made even, the rate of loading and velocity of pendulum both increase with θ. The practical compromise is to allow the scale to open out slowly, keeping the rate of loading practically constant and to ensure that the accelerations do not introduce appreciable errors.

The three conditions are fully satisfied in practice by the round value $\lambda = 0{\cdot}50$, rather less than the optimum when evenness of scale alone is considered. In order to obtain numerical values from the above formulæ, the value of R/Er must be known. As the variations are not very sensitive to this value, it may be taken as 0·724, which is that for a yarn breaking at 325 gms. with an extension of 1 in. on a machine of range 470 gms., the pulley radius being 2 in.

On this point, it may be noticed that Equation 8 may be written—

$$\frac{\delta f}{\delta t} = \frac{vk}{1 + k/E}$$

where $$k = \frac{R}{r} \cdot \frac{\lambda + \cos\theta}{(1 + \lambda\cos\theta)^3}$$

is a constant of the machine. Comparison between machines is usually made by a quantity called "the machine rate of loading," which is the change of tension on an inextensible specimen for unit traverse of the loading jaw. This quantity is the constant k for, when $1/E$ is zero, $\delta f/v\delta t = k$.

On the other hand, for very extensible threads, the rate of loading tends to become independent of the machine and approach the value $\delta f/\delta t = vE$.

In practice, breaks usually occur when the lever is about the middle of the scale and the extensibility of single cotton yarn rarely varies outside 4—6%, so that the representative value taken for R/Er gives a much better approximation to actual conditions than the limiting values of zero and infinity, when the subject is the variation over the scale of any one machine.

The momentum error in the machine with eccentric roller was evaluated to be under 0·1 milligm. at 60° inclination, the free period being 1·0 second. The condition of steady motion may therefore be ignored. The variations of sensitivity and rate of loading are shown in Table I. and, when $\lambda = 0{\cdot}50$, are too small to be any disadvantage. With a concentric pulley, specimens should be tested on a machine of such range that the inclination does not exceed 60°.

Table I.

Ratio of Value of Quantities to that at Zero

Inclination, θ ...	60°	60°	90°	90°	0°
Eccentricity, λ	0	0·5	0	0·5	–
Scale divisions, $\delta\theta/\delta f$ ...	2·0	1·04	∞	1·33	1
Rate of loading, $\delta f/\delta t$ ...	0·63	1·11	0	1·09	1

In studying the effect of rate of loading on breaking load, the results are conveniently expressed against the time which would be occupied in breaking the specimen at the rate of loading which obtains at rupture, which is given by—

$$T = f/\frac{\delta f}{\delta t} = \frac{r}{v} \cdot \left[\frac{f}{R} \cdot \frac{(1 + \lambda \cos \theta)^3}{\lambda + \cos \theta} + \frac{e}{r}\right] \quad . \quad . \quad . \quad (10)$$

where the values of f, $\frac{\delta f}{\delta t}$, θ, and e are those at rupture.

For the particular machine used for the work of Paper III.—

$$T = \frac{120}{v} \cdot \left[\frac{f}{470} \cdot \frac{(1 + \frac{1}{2} \cos \theta)^3}{\frac{1}{2} + \cos \theta} + \frac{e}{5{\cdot}08}\right] \text{ seconds} \quad . \quad . \quad (10a)$$

The value of $\dfrac{(1 + \frac{1}{2} \cos \theta)^3}{\frac{1}{2} + \cos \theta}$

changes slowly and in the neighbourhood of 340 gms. is 1·94.

$$\therefore T = (0{\cdot}495\, f + 23{\cdot}6\, e)/v \text{ seconds} \quad . \quad . \quad . \quad . \quad (10b)$$

Before leaving the question of deadweight machines, the possible error due to overswinging should be considered. Suppose the pointer to continue to move after the specimen is ruptured, through an angle $\Delta\theta$, then neglecting friction—

$$\tfrac{1}{2}\, I\, \dot{\theta}^2 = Mgh - \Delta \cos \theta. \quad . \quad . \quad . \quad . \quad . \quad (Xa)$$

Substituting values given by Equations 6, 7, and 9a, and simplifying, the false increment to the breaking load is given by—

$$\Delta F = R\, \frac{v^2 T^2}{8\pi^2 r^2} \cdot \frac{\lambda + \cos \theta}{\sin \theta} \cdot \left[(1 + \lambda \cos \theta)^2 + \frac{R}{Er} \cdot \frac{\lambda + \cos \theta}{1 + \lambda \cos \theta}\right]^{-2} \quad (X)$$

For the particular instrument described above, the factors independent of θ reduce to 470/7896 gms. and the error, assuming

$$\frac{R}{Er} \text{ is } 0{\cdot}724,$$

is 0·015 gm. at 60°, 0·021 gm. at 30°. This is far below the limit of reading but with a smaller roller, longer pendulum, higher speed, and

less extensible material the error may become appreciable, and it is well to check this point by Equation (X) for any given instrument used in research testing.

MOSCROP MACHINE

The tension is measured by the extension of a spring working well within the limits of perfect elasticity, so the scale is accurately even. It is also sensitive enough for practical purposes.

As the inertia of the spring itself is very small and the extension too small to introduce elastic after-effects, the ratio of tension to extension is also independent of the speed. This may be experimentally verified over the large interval of speed between static calibration and free vibration. The period of free vibration is given by

$$T = 2\pi\sqrt{M/\mu}$$

where M is the load, μ the tension per unit extension during oscillation. Testing a spring of set No. 3 (maximum 16 oz.), steady calibration gave 0·316 cm. per oz. The time of vibration under an 8 oz. load was 0·32 sec., under a 13 oz. load 0·405 sec., giving 0·314 and 0·316 cm. per oz. respectively.

It follows also that the rate of loading would be constant if the loading jaw moved at constant speed and the tension on the yarn was equal to that on the spring. Any variations and errors must therefore be introduced by accelerations of the loading jaw and by the momentum and friction of the recording jaw.

The loading jaw is moved by a lever passing through a swivelled nut on the carriage. This lever is oscillated by a pin, on a uniformly rotating wheel, which passes freely up and down a slot in the lever. The geometrical conditions are shown in the diagram, Fig. 1; AQ, a fixed distance r, rotates at a constant angular velocity ω about A; OC moves so that it always passes through Q; P is the intersection of OC and the fixed horizontal line BP, and is a fixed point on the carriage. The length of BP, x, therefore defines the displacement of the loading jaw (positive to the right) from its position when the lever is vertical. Let x_0 be its value when the jaw closes at the beginning of loading, and let p be the number of complete cycles per minute. Then—

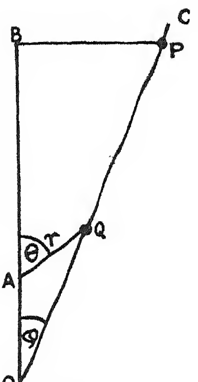

Fig. 1

$$x = \text{OB} \tan\varphi, \text{ where } \tan\varphi = \frac{\text{AQ} \sin\theta}{\text{AO} + \text{AQ}\cos\theta}$$

$$= b \cdot \frac{r \sin \omega t}{a + r\cos\omega t} \quad . \quad . \quad . \quad . \quad . \quad (11)$$

$$\dot{x} = \omega b r \cdot \frac{a\cos\omega t + r}{(a + r\cos\omega t)^2} \quad . \quad . \quad . \quad . \quad . \quad (12)$$

$$\ddot{x} = -\omega^2 b r \sin\omega t \cdot \frac{a^2 - r^2}{(a + r\cos\omega t)^3}$$

$$= -\omega^2 x \cdot \frac{a^2 - r^2}{(a + r\cos\theta)^2} \quad . \quad . \quad . \quad . \quad . \quad (13)$$

If y be the displacement of the recording slide from its zero position and the extension of the thread be $e = f/E$, where f is the tension in the thread—

$$x - x_0 = e + y \text{ and } f = E(x - x_0 - y). \quad . \quad . \quad . \quad . \quad . \quad (14)$$

As the spring is slightly extended at the zero position, let y_0 be the extension corresponding to the initial tension. The tension of the spring is

$$f' = \mu\,(y + y_0) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (15)$$

The slide of the recording jaw is mounted on rollers with a very slight slope forwards, nicely adjusted so that the small forces due to friction and gravity neutralise each other in forward movement. Expressing the tensions in gravitational units, $f' = f - M\ddot{y}/g$, where M is the mass of the slide.

$$\therefore \mu\,(y + y_0) = E(x - x_0 - y) - M\ddot{y}/g$$

or $\quad M/g\,.\,\ddot{y} + (E + \mu)\,y = Ex - (\mu y_0 + Ex_0)$

$$= Ebr \cdot \frac{\sin\,\omega t}{a + r\,\cos\,\omega t} - (\mu y_0 + Ex_0) \quad . \quad . \quad . \quad (16)$$

Equation 16 is the differential equation of motion, with this reserve, that E is not a constant under oscillating tension. The initial jerk is rapidly damped out by elastic imperfection and the motion of the slide is thereafter steady except for the slow variation in speed of the loading jaw. Under conditions defined below, when the effective force of the slide is small in comparison with the tension, the term $M/g.\ddot{y}$ may beneg lected, giving—

$$y = \frac{E}{E + \mu} \cdot x - \frac{\mu y_0 + Ex_0}{E + \mu} = \frac{E}{E + \mu}\,(x - x_0) - \frac{\mu}{E + \mu} \cdot y_0 \qquad (17)$$

$$\dot{y} = \frac{E}{E + \mu} \cdot \dot{x} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

$$\ddot{y} = \frac{E}{E + \mu} \cdot \ddot{x} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (19)$$

The errors introduced by the momentum at the moment of rupture are—

(1) The difference between the tension of the yarn and of the spring due to acceleration of the slide which, denoting final tensions by the capital F, is—

$$F' - F = -\,M\ddot{y}/g \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

and either (2) or (3), whichever be greater.

(2) The extension of the spring after rupture due to the momentum of the slide; the amount of this error, $\Delta' F$, is given by the energy equation—

$$\Delta' F/\mu \times F'\,.\,g = \tfrac{1}{2} M\,.\,\dot{y}^2$$

or

$$\Delta' F = \frac{\mu M}{2F'} \cdot \frac{\dot{y}^2}{g} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

(3) The fling of the recording pin, $\Delta F/\mu$, beyond the point where it is pushed by the slide. If m be its mass, ν the frictional coefficient—

$$\nu m g\,.\,\Delta F/\mu = \tfrac{1}{2} m\dot{y}^2$$

or

$$\Delta F = \frac{\mu}{2\nu g} \cdot \dot{y}^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (22)$$

The ratio $\Delta F/\Delta' F = F'/\nu M$ is of the order 10, hence errors (1) and (3) only need be considered. The difference between the indicated strength, F_i, and the maximum tension in the yarn, F_m, is—

$$F_i - F_m = \frac{1}{g}\left(\frac{\mu}{2\nu} \cdot \dot{y}^2 - M\ddot{y}\right) \quad . \quad . \quad . \quad (23)$$

all the quantities referring to the moment of rupture. From Equations (18) and (19)—

$$F_i - F_m = \frac{1}{g} \cdot \frac{E}{E + \mu} \left(\frac{\mu}{2\nu} \cdot \dot{x}^2 - M\ddot{x} \right) \quad . \quad . \quad . \quad (23a)$$

All the quantities on the right of the equation are known except ν and E, which depends on the specimen.

Taking an actual case of a yarn breaking at 16 oz., extending 2·0 cms., tested at 8 cycles per minute against springs for a maximum strength of 32 oz.—M=4·17 oz.; ω=0·84 radian per second; E=8·0 oz. per cm.; μ=6·33 oz. per cm.; $E/(E + \mu)$ = 0·558; μy_0= 2 oz.; y = 2·21 cm.; $x - x_0$= 4·21 cm.; x = 14·41 cm. at break;

$$\text{Cos } \theta = (\sqrt{1 - 9{\cdot}7x^2/b^2} - 3{\cdot}27x^2/b^2) \,/\, (1 + x^2/b^2) = 0{\cdot}5369.$$

$$\dot{x} = 0{\cdot}10472\, p \times \frac{3{\cdot}27 \cos \theta + 1}{(3{\cdot}27 + \cos \theta)^2} \times 65{\cdot}5 = 10{\cdot}43 \text{ cm. per second.}$$

$$\ddot{x} = -\,\omega^2 x \cdot \frac{9{\cdot}7}{(3{\cdot}27 + \cos \theta)^2} = -\,6{\cdot}77 \text{ cm. per second.}$$

$$\text{The effective force error} = \frac{1}{g} \cdot \frac{E}{E + \mu} \cdot -\,M\ddot{x} = 0{\cdot}020 \text{ oz. on 16 ozs.}$$

This is equal to 1/100th of an interval on the record and is negligible.

The error due to the sliding of the pin is—

$$\frac{1}{g} \cdot \frac{E}{E + \mu} \cdot \frac{\mu}{2\nu} \cdot \dot{x}^2 = 0{\cdot}196/\nu \text{ oz.}$$

A slight upward inclination of the bed of the recording pin increases the effective value of ν, but, as the coefficient of friction between polished metal surfaces is of the order 0·2, this error may attain serious proportions in normal working.

As the research on rate of loading demanded enhanced speeds, the error had to be measured. This was done by placing a metal bar across the machine to stop the slides at a definite position near the breaking point of the yarn used in that research. The position of rupture being kept constant, the fling of the pin should be proportional to p^2. On Fig. 2 are shown the measured flings plotted against p^2. Below 5 cycles per minute, these are too small to be measured, but they increase rapidly in linear relation with p^2, the deviations being irregular and of the order of 0·2 mm., which cannot be regarded as significant. The fling was shorter and more regular when the pin was vaselined, being then 0·0064 p^2 mm. At the usual rate of 8 cycles per minute, this gives a fling of 0·4 mm.—rather more than 1/10th of an interval. It would be safer to make the standard rate 6 cycles per minute, 1 in 10 seconds, when the error is inappreciable.

The recording slide starts into motion with a jerk which may damage the yarn, for the moving jaw closes when travelling at 11·86 cm. per second (at 8 cycles per minute). This sets up an oscillation, but as it is very highly damped, the effective force in the first half period will show the likelihood of injury. Its magnitude may be found from Equation (16), simplified by taking the velocity of the loading jaw as constant at the value when the closes.

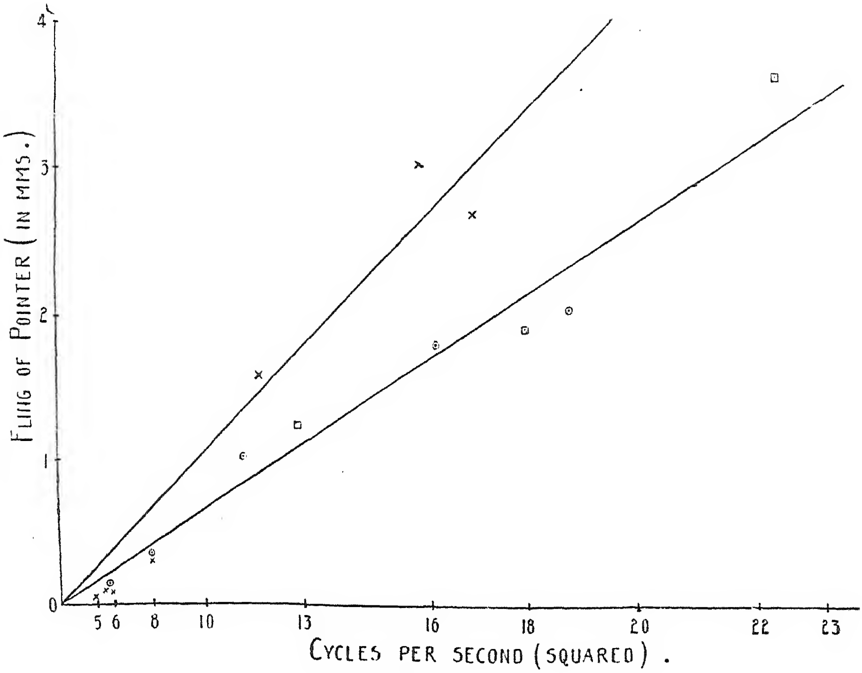

FIG. 2

Then $M/g \,.\, \ddot{y} + (E + \mu)y = E(x - x_0) - \mu y_0$

$$= E\dot{x}_0(t - t_0) - \mu y_0 \qquad \text{(16a)}$$

which may be written in the form—

$$(D^2 + a)y = bt' \qquad \text{(16b)}$$

where $a = \frac{g}{M}(E + \mu)$, $b = \frac{gE}{M} \cdot \dot{x}_0$, and $t' = t_0 + \frac{\mu y_0}{E\dot{x}_0}$, $dt' = dt$

The solution obtained by the general method is—

$$y = A \cos \sqrt{a} \,.\, t' + B \sin \sqrt{a} \,.\, t' + bt'/a$$

$$\text{and } \dot{y} = - A\sqrt{a} \sin \sqrt{a} \,.\, t' + B\sqrt{a} \,.\, \cos \sqrt{a} \,.\, t' + b/a$$

When the tension of the thread just equals the initial tension of the spring, $t' = 0$, $y = 0$, and $\dot{y} = 0$, whence $A = 0$ and

$$B = -\frac{b}{a\sqrt{a}} \cdot$$

Substituting, $y = \frac{b}{a}\left(t' - \frac{1}{\sqrt{a}} \cdot \sin \sqrt{a}\, t'\right)$

$$\dot{y} = \frac{b}{a}(1 - \cos \sqrt{a}\, t')$$

$$\ddot{y} = \frac{b}{\sqrt{a}} \cdot \sin \sqrt{a}\, t'$$

$$M/g\, \ddot{y} = E\dot{x}_0 \cdot \frac{1}{\sqrt{a}} \sin .\, 2\pi \cdot \frac{t'}{2\pi/\sqrt{a}} \cdot \qquad \text{(24)}$$

The oscillation of stress set up by the initial jerk has then an amplitude $E\dot{x}/\sqrt{a}$ and a period $2\pi/\sqrt{a}$. A similar oscillation is set up if the slide be held at rest under a slight tension of yarn and spring, and then disturbed. By trial the period is then a small fraction of a second as given by Equation (17), but the vibration is so highly damped that two periods can scarcely be detected. The amplitude under testing conditions is greatest when $t' = \pi/2\sqrt{a}$, succeeding oscillations being much less than given by the formula.

An extension of 5% and a break at the middle of the record give a value of E, $0{\cdot}3R$, which should be close to the value in most cases, while μ is always $0{\cdot}2R$ approximately, where R is the maximum reading of the record.

The amplitude of the initial jerk stress—

$$E\dot{x}_0/\sqrt{a} = 0{\cdot}0967\,\frac{E}{\sqrt{E+\mu}}\cdot p \qquad (25)$$

$$= 0{\cdot}1368\ E\ p/\sqrt{R}$$

$$= 0{\cdot}041\ p\sqrt{R}\ \text{oz. approx.}$$

The period of the oscillation—

$$2\pi/\sqrt{a} = 0{\cdot}41/\sqrt{E+\mu} \qquad (26)$$

$$= 0{\cdot}58/\sqrt{R}\ \text{sec. approx.}$$

The time from loading to rupture $(\theta - \theta_0)/\omega$

$$= (\theta - 0{\cdot}6816)/0{\cdot}1047\ p\ \text{sec.}$$

$$= 3{\cdot}08/p\ \text{sec. for a break at } \tfrac{1}{2}R.$$

For higher speeds and weaker springs therefore the initial jerk is more serious and the oscillations have less time to die down. As examples—
When $R = 4$ oz., $p = 8$ per minute,

then the amplitude $= \frac{2}{3}$ oz. on a 2 oz. breaking load.
the period $= 0{\cdot}29$ sec.,
and the time of break $= 0{\cdot}39$ sec.

Results under these conditions would be quite untrustworthy and the machine must be slowed down very considerably when using these weaker springs. As an arbitrary criterion it might be laid down that the period should not exceed one fourth of the time of break, nor the amplitude one fourth of the breaking load, the safe speed then being found from Equations 25 and 26—
When $R = 32$ oz., $p = 6$ per minute,

the amplitude $= 1{\cdot}85$ oz. on a 16 oz. breaking load.
the period $= 0{\cdot}10$ sec.,
and the time of break $= 0{\cdot}51$ sec.

Under these conditions results will be unaffected. The frequency curve of breaking loads in this case is shown in Fig. 3, Curve I., and the effect of increased speed is clearly shown in the Curves II. and III.

The rate of loading, ignoring momentum errors, is given by—

$$\delta f/\delta t = \mu\dot{y} = \frac{\mu E}{E+\mu}\cdot\dot{x} \qquad (27)$$

The velocity of the loading jaw, $\dot{x}$ (Equation 12), decreases during the loading from 11·9 cm. per second to 10·4 cm. per second at $R/2$, and 8·0 cm. per second at the top of the record, but this is not enough to affect the strength seriously. Using the same approximations as before, the rate of loading at rupture is 0·156 $p.R.$ oz. per second.

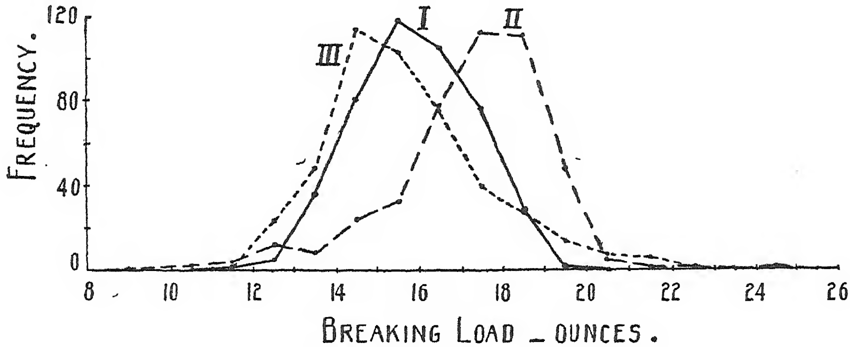

FIG. 3

Final extension 6·5%; 32 oz. spring; period of oscillation 0·11 sec.

I.—At 6 cycles per minute. Initial jerk 2·7 oz. Time of break 0·51 sec. Correction −0·15 oz. Normal frequency curve.

II.—At 18 cycles per minute. Initial jerk 3·7 oz. Time of break 0·17 sec. Correction −1·33 oz. Breaking load of most frequent group increased by greater speed but some 50 of the weaker threads affected by initial jerk.

III.—At 22·5 cycles per minute. Initial jerk 4·6 oz. Time of break 0·14 sec. Correction −2·06 oz. Most frequent group affected by initial jerk but many of the strong threads showing the normal increase of breaking load.

LOAD-EXTENSION INSTRUMENT

The equations of motion for the type of machine designed by Shorter and Hall[3] are very similar to those for the Moscrop tester, but there is more opportunity to vary the parts in order to eliminate errors. Oscillating stresses are overcome by making the period of the spring with recording jaw small in comparison with the time of break, the necessary calculations being given in the paper quoted. The driving mechanism can be arranged at will; the velocity of the moving grip can be made constant and the initial jerk avoided by using an oil-plunger drive.

The rate of loading is given by Equation 27, as for the Moscrop machine. When the carriage is moved steadily, the openness of scale, rate of loading, and momentum of recording system are all very nearly constant.

There is no friction to disturb the measurement, that of the recording needle on the glass plate being almost infinitesimal.

BALLISTIC TESTER

The essential point in the construction of a ballistic tester is to ensure that no appreciable energy is lost in the swing apart from that absorbed by the specimen. To this end, the anchorage, pendulum, and frame must be made rigid, that is, the distortion due to the breaking stress must be quite negligible compared with the extension of the specimen. The line of application of the stress must pass through the centre of percussion of the pendulum in order to avoid impulsive bending moments in the pendulum and reactions on the support.

The rigidity of the parts, friction of the bearings and pointer, dead stop of the latter, and uniformity of release are arranged for in the present instrument by mechanical details which were considered in Paper II. and which ensure freedom from the corresponding errors. Dynamical analysis is necessary to calculate the position of the centre of percussion, the energy and the rate of break.

If, as in the present case, the pendulum has two planes of symmetry intersecting in the longitudinal axis, its dynamics can be fully described by its mass, radius of gyration, and the position on the axis of the centres of suspension, of gravity, and of percussion. The grip for the specimen is made to coincide with the last point, preliminary calculations for the design of the pendulum having been made to ensure that its position would be convenient.

The mass M was found by weighing to be 3524·1 gms., the distance from the centre of suspension to the centre of gravity l was found by balancing on a knife edge to be 26·16 cm. The distance to the centre of percussion l_0 is obtained from the period of the pendulum—

$$t = 2\pi\sqrt{l_0/g} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (28)$$

The time of vibration was 1·24 secs., giving l_0 38·2 cm. Measurement from the centre of the axis to the centre of the rod on which the grip is placed gave 37·8 cm. in the finished machine. A rider was provided to adjust any such difference, but was not used as the disparity is sufficiently small. The radius of gyration, k, is given by the formula—

$$k^2 = l\,l_0 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (29)$$

as 31·6 cm. The moment of inertia $I = Mk^2 = 1{\cdot}114 \times 10^5$ gm. cm.^{2}

If θ_0 be the angular displacement of the pendulum at release, the height of the centre of gravity above its position at the bottom of the swing—

$$h_0 = l\,(1 - \cos\,\theta_0) \quad . \quad . \quad . \quad . \quad . \quad (30)$$

In falling this height, the kinetic energy acquired is $Mgh_0 = \frac{1}{2}Mk^2\omega_0{}^2$, and the angular velocity at the bottom of the swing—

$$\omega_0 = \sqrt{2gh}/k. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (31)$$

The energy gained in falling from the horizontal position—

$$\begin{aligned} Mgl &= 9{\cdot}05 \text{ joules.} \\ &= 92{\cdot}17 \times 10^3 \text{ gm. cm.} \\ &= 6{\cdot}67 \text{ feet-lbs.} \\ &= 80{\cdot}1 \text{ inch-lbs.} \end{aligned}$$

The scale is graduated in fractions of the total height of fall (equal intervals of $1 - \cos\,\theta$), and absolute values of the work are found by multiplying readings by the above values for the total capacity.

If a specimen be broken at the bottom of the swing, the centre of gravity rises to a height h_1 and the work of rupture—

$$\begin{aligned} W_1 &= Mg(h_0 - h_1) \\ &= Mgl\,(\cos\,\theta_1 - \cos\,\theta_0) \\ &= \int f\,.\,de \end{aligned}$$

where f is the force on the specimen at any moment, e its extension.

When the specimen is a lea of yarn in positive grips, the manner of break is given by the case analysed in Paper V. of gripped threads originally at the same tension. The complications involved in measuring the breaking load do not concern the measurement of work of rupture, but affect the precise rate at which the tension increases. Up till the rupture of the first thread, the tension increases proportionally with the extension, the ratio of load to extension ($E = f/e$) being the sum of the ratios for the individual threads. Thereafter the rate of increase diminishes to zero at the maximum load, the tension decreases, and suddenly ceases. The change of tension with extension during rupture is given by Equation (8c), *loc. cit.*, but not in a form suitable for calculation.

The rate of break and of loading for a specimen obeying Hooke's Law to rupture is more generally applicable and close enough to actual cases for practical purposes. The fixed grip of the tester is placed so that the specimen comes under tension just before the bottom of the swing and rupture is complete just after. During the extension, the pendulum grip is moving practically in a straight line with velocity $v = \omega l_0$, and

$$Mk^2 \frac{d\omega}{dt} = -f \, . \, l_0$$

$$\therefore f = Ee = -M \, . \, \frac{k^2}{l_0^2} \cdot \frac{dv}{dt}$$

$$\text{and } \frac{d^2e}{dt^2} = -\frac{l_0}{l} \cdot \frac{E}{M} \cdot e = -Ae \qquad (32)$$

Whence $$v = \frac{de}{dt} = \sqrt{C - Ae^2} = \left[\frac{2l_0}{Ml}\left(Mgh - \tfrac{1}{2}Ee\right)\right]^{\frac{1}{2}} \qquad (33)$$

where C is a constant of integration whose value is given by—

$$C = v^2 = 2gh_0 \cdot \frac{l_0^2}{k^2} = 2gh_0 \cdot \frac{l_0}{l} \, .$$

Integrating $t\sqrt{A} = \sin^{-1}\dfrac{e}{\sqrt{C/A}} + C_1$

When $t = 0$, $e = 0$, and $C_1 = 0$

$$\therefore t = \frac{1}{\sqrt{A}} \cdot \sin^{-1}\frac{e}{\sqrt{C/A}}$$

$$= \sqrt{\frac{l_0}{l} \cdot \frac{M}{E}} \cdot \sin^{-1} e\sqrt{\frac{E}{2Mgh_0}} \qquad (34)$$

The duration of the process of rupture is given by substituting the limiting extension for e. In the case of a lea, the mean breaking extension of single threads will give a sufficiently accurate measure of this slightly indeterminate time. It can also be expressed in the forms—

$$t = e\sqrt{\frac{Ml}{2Wl_0}} \cdot \sin^{-1}\sqrt{\frac{W}{W_0}} = \frac{0{\cdot}116e}{\sqrt{R - R_0}} \cdot \sin^{-1}\sqrt{\frac{R_0 - R}{R_0}} \text{ sec.} \qquad (34a)$$

the last applying to the particular machine, where R is the reading in 1/1000ths of the total capacity corresponding to the kinetic energy at the time t.

The rate of extension—

$$\frac{de}{dt} = \sqrt{\frac{2l_0}{Ml}} \cdot \sqrt{W_0 - W} = 8{\cdot}614\sqrt{R} \text{ . cm./sec.} \qquad (35)$$

and the tension at time t—

$$f = \frac{2}{e_1}\sqrt{W_1 W_0} \cdot \sin\sqrt{\frac{2l_0}{Ml}} \cdot \frac{\sqrt{W_1}}{e_1} \cdot t$$

$$= 184{\cdot}34\sqrt{R_0(R_0 - R_1)} \;/\; e_1 \,.\, \sin 8{\cdot}614\sqrt{R_0 - R_1}/e_1 \,.\, t \qquad (36)$$

where e_1 is the final extension.

The time which would be taken in stretching to rupture at the rate of extension obtaining just before rupture is—

$$T = e_1 \Big/ \frac{\delta e_1}{\delta t} = \frac{0{\cdot}116 e_1}{\sqrt{R_1}} \qquad (37)$$

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32—X.—TENSILE TESTS FOR COTTON YARNS v.—"THE WEAKEST LINK" THEOREMS ON THE STRENGTH OF LONG AND OF COMPOSITE SPECIMENS

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INTRODUCTION AND SUMMARY

It is a truism, of which the mathematical implications are of no little interest, that the strength of a chain is that of its weakest link. It is equally true that the strength of a test specimen is that of its weakest element of length, whether it be a metal rod, a thread of yarn, or a cotton hair. This fact distinguishes the quantity, breaking load, from most other quantities, such as weight of which the value is determined by the average over all elements of the length. Tensile strength thus decreases with the length of specimen in a way which is definitely calculated from the distribution of strength of short specimens. The decrease in mean strength and in irregularity is directly proportional to the irregularity of the short specimens and to a factor, depending only on the multiple by which the length is increased and very simply calculated therefrom.

Variability along a specimen is shown necessarily to introduce negative skewness into all frequency curves of strength, counteracting or reinforcing any skewness that may arise from methods of production, and this must be taken into consideration when drawing conclusions from the shape of strength frequency curves. In cotton yarns, the method of production tends to produce positive skewness which is found with specimens of 3 inches. This is obliterated to yield a symmetrical curve by increasing the length to a foot or so, while leas show decided negative skewness. More generally, skewness is produced by irregularity in the frequency curves of any quantity "when the deviations of individual values are affected unequally by equal deviations of opposite sign among the constituent elements of a specimen," a criterion which fits most elastic measurements.

The relations between the strength of fibres, yarns, leas, and fabrics have often been studied empirically, but they are subject to so many disturbing factors that measurements do not lead to definite or simple conclusions, in the absence of a logical basis for comparing the results. In the present paper, five cases of specimens composed of parallel elements are analysed for a relation between the strength of the whole and of the parts. Actual specimens of all kinds of materials may reproduce the conditions more or less closely. The lea test can be brought under a simple case if modified as suggested in Paper I. of this series.

A correction is given for measurements of tendering when only a fraction of the length of a specimen is subjected to treatment, such as wear or exposure to light.

The present paper is mathematical throughout, but the conclusions are condensed into simple forms applicable to experimental results in this series or elsewhere.

VARIATION OF STRENGTH WITH LENGTH

Let the distribution of the breaking loads of specimens of length l be expressed by a frequency curve, $y_1 = \varphi(f)$, where $y_1 \delta f$ is the probability that the strength of any given specimen should lie between f and $f + \delta f$, and further suppose that this function does not vary significantly from one portion to another of the whole batch of specimens.

The probability that the strength of any one thread should not be less than f is

$$\int_f^\infty \varphi(f)\,.\,df$$

that one of r lengths has a strength lying between f and $f + \delta f$ is $r\varphi(f)\,.\,df$; that none of the others has a strength less than f is

$$\left[\int_f^\infty \varphi(f)\,.\,df\right]^{r-1}$$

Hence the probability that the breaking load of any given specimen of length rl lies between f and $f + \delta f$ is $y_r\,.\,\delta f$, where

$$y_r = r\varphi(f)\left[\int_f^\infty \varphi(f)\,.\,df\right]^{r-1} \qquad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This is a general expression independent of the form of the frequency curve provided only this be not also a function of the position of the specimen. It may be applied to any empirical frequency curve to deduce the distribution of strength in specimens of multiple lengths by giving each observation the weight $r\,(N'/N)^{r-1}$ where N' is the number of specimens of equal or greater strength, N the total number, or by the expression—

$$y_r = r\,\Sigma\,(N'/N)^{r-1} \qquad . \quad . \quad . \quad . \quad . \quad . \quad (1a)$$

the summation extending over the y_1 specimens in the interval.

Taking as an example the measurements on 10 in. and 30 in. lengths of 32's American ring yarn, of which the results are given in Table I. of Paper I., the distribution for the 30 in. lengths deduced from that for the 10 in. lengths are compared with the observed distribution in Table I. below (last two rows).

Table I.

Comparison of Breaking Loads of 10 and 30 in. specimens—32's American Ring Yarn

Interval	130 to	140	150	160	170	180	190	200 gm.
y_1	0	0	3	10	20	18	29	24
N'	200	200	−198	−188	−168	−150	−121	−97
$3\Sigma(N'/N)^2$ ...	—	—	9	28	46	34	39	21
y_3	2	0	3	12	27	38	33	29
Interval	210 to	220	230	240	250	260	270	280 gm.
y_1	23	36	17	8	8	3	0	1
N'	−74	−38	−21	−13	12−5	4−2	1	1
$3\Sigma(N'/N)^2$ ...	13	9	1	0	0	0	0	0
y_3	24	14	10	7	1	0	0	0

The derived and observed distributions agree well enough, considering the small number of observations for the operation of the law of probability, but show a discrepancy due to a general property of yarn. The actual loss

in strength and decrease in spread are less than those calculated because the average deviation between consecutive specimens is less than that between specimens widely separated or chosen at random, i.e. $\varphi(f)$ fluctuates along the length to a slight extent.

The frequency curves from the tests on 600 specimens of 9 in. and 27 in. lengths are shown in Fig. 1. The observed curve for the longer length (II)

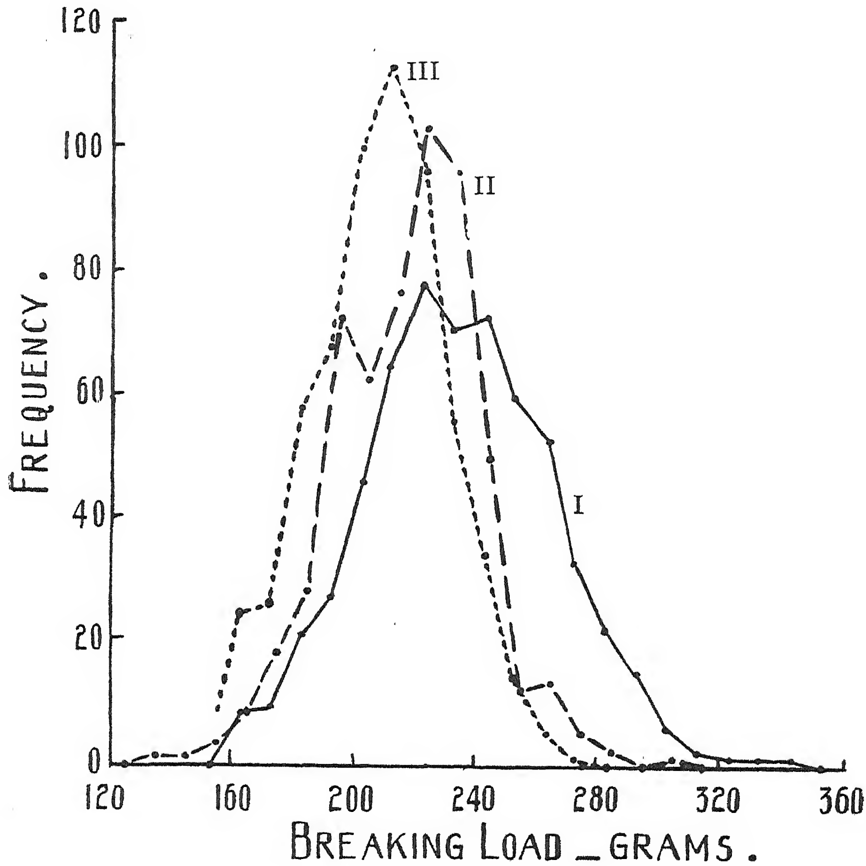

FIG. 1

shows a marked decrease in mean strength and in standard deviation, but the change is less than that given by the transformation (III) of the curve for the short specimens (I).

To obtain an analytical expression for the variation with length, it is necessary to assume one for the original frequency curve. Though observed frequency arrays are commonly irregular and may be skew, the normal curve is the most convenient general form and gives a sufficiently close approximation for the present purpose. The distribution of strength for a multiple length is then given by writing in Equation (1)—

$$\varphi(f) = \frac{h}{\sqrt{\pi}} e^{-h^2 (f-a)^2} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where a is the mean and h the "modulus of precision" for lengths l, the latter being equal to $1/\sqrt{2}\sigma$ (σ being the Standard Deviation). Then, writing $f - a = x$

$$y_r = r \cdot \frac{h}{\sqrt{\pi}} \cdot e^{-h^2x^2} \left[\frac{1}{\sqrt{\pi}}\int_0^\infty e^{-h^2x^2} \cdot hdx - \frac{1}{\sqrt{\pi}}\int_0^x e^{-h^2x^2} \cdot hdx\right]^{r-1}$$

$$= \frac{h}{\sqrt{\pi}} \cdot e^{-h^2x^2} \cdot r \left[\frac{1 - \Phi(hx)}{2}\right]^{r-1}, \text{ where } \Phi(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-x^2} \cdot dx \qquad (1b)$$

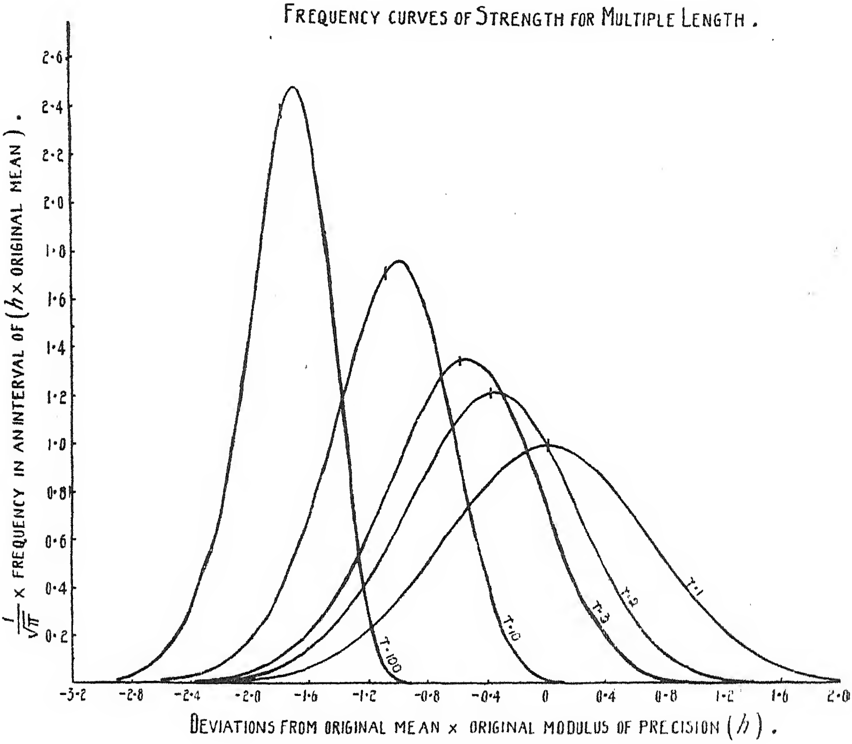

FIG. 2

The error function, $\Phi(x)$, cannot be obtained in the form of an integrated algebraic expression, and in consequence no such form can be obtained for the frequency function, y_r, the mean or standard deviation of the breaking loads of specimens of length rl. The error function can, however, be integrated by series and tables of its values are published. From these, curves have been drawn (Fig. 2) showing a normal frequency curve for a length l and the derived curves for lengths $2l$, $3l$, $10l$, and $100l$. For simple and general application, these have been plotted against multiples of hx for abscissa and $1\sqrt{\pi}$ for ordinate.

It will be seen that the mean strength decreases continuously with length, and the height of the peaks show that the standard deviation also

decreases. In addition the curves become negatively skew so that the mean, median, and mode are no longer identical. Of these, the last two can be obtained without integrating y_r.

The mode is given by the condition—

$$\frac{d}{df} \cdot y_r = 0$$

or

$$\varphi(f) \cdot \left[\int_f^{\infty} \varphi(f) \, . \, df\right]^{r-2} \cdot \left\{(r-1)\,\varphi(f) + 2h^2(f-a)\int_f^{\infty} \varphi(f) \, . \, df\right\} = 0$$

The first two factors are zero when $f = \pm\infty$, the mode being given by the condition that the expression in curly brackets be zero, or—

$$\frac{h^2(a-f)}{\varphi(f)} \cdot \int_f^{\infty} \varphi(f) \, . \, df = \frac{r-1}{2}$$

or

$$\frac{hx}{e^{-h^2x^2}}\left[\frac{1-\Phi\,(hx)}{2}\right] = -\frac{r-1}{2\sqrt{\pi}} \qquad . \quad . \quad . \quad (2a)$$

The median is given by the condition that one half the specimens contain a length l of strength less than the median, i.e. the probability that 1 in r lengths has a strength less than the median is $\frac{1}{2}$. The probability that any one length deviates below the mean by more than hx is

$$\frac{1-\Phi\,(hx)}{2}$$

that one or more of r lengths shows such a deviation is

$$1-\left[1-\frac{1-\Phi\,(hx)}{2}\right]^r = 1-\left[\frac{1+\Phi\,(hx)}{2}\right]^r$$

which probability is $\frac{1}{2}$ for strengths below the median of lengths rl. Hence, if hx be the deviation from the original mean of this median,

$$\left[\frac{1-\Phi\,(hx)}{2}\right]^r = \frac{1}{2} \qquad . \quad . \quad . \quad . \quad . \quad (3)$$

or

$$\frac{1-\Phi\,(hx)}{2} = 2^{-\frac{1}{r}}$$

The mean strength of the multiple lengths, a_r, is given by

$$a_r = \int_{-\infty}^{+\infty} y_r . f \, . \, df \qquad . \quad . \quad . \quad . \quad (4)$$

which can in general only be evaluated by calculations from plotted curves.

It is a simple matter to plot the functions of (hx) on the left hand side of Equations (2a) and (3), and read off the values which satisfy these equations for any value of r. A number of such values are shown in Table II. and the curves for the decrease in median and mode are given in Fig. 3. It is generally approximately true of a skew curve that the difference between the mean and mode is three times that between mean and median. The values of the mean obtained on this assumption are also shown.

Table II.*
The Strength of Multiple Lengths

r	Mode	Median	Mean	S.D.$\times\sqrt{2}$	—Sk.	$r^{-\frac{1}{5}}$	$3(1-r^{-\frac{1}{5}})$
1	0	0	0	1	0	1	0
2	·360	·386	·399	·82	·067	·87	·388
3	·543	·580	·598	·74	·106	·80	·592
4	·663	·705	·726	·70	·128	·76	·727
5	·751	·797	·820	·66	·147	·72	·826
10	1·006	1·062	1·09	·58	·205	·63	1·11
30	1·351	1·414	1·45	·49	·271	·51	1·48
40	1·434	1·496	1·53	·48	·276	·48	1·57
80	1·622	1·688	1·72	·44	·316	·42	1·75
100	1·679	1·743	1·77	·42	·324	·40	1·81
160	1·796	1·860	1·89	·41	·334	·36	1·91
275	1·922	1·988	2·02	·39	·358	·33	2·02
1000	2·202	2·266	2·30	·35	·388	·25	2·25

*The Skewness, $Sk = \dfrac{\text{Mean-Mode}}{\text{S.D.}}$. The other quantities are given as the deviation below the original mean multiplied by the modulus of precision h of the normal curve for $r = 1$. As mean and mode are found from plotted curves, the last figure is uncertain. To express these values as ratios of the S.D. of the original curve, multiply by $\sqrt{2}$.

The value for S.D. $\times \sqrt{2}$ is the inverse of the height of the curve, in Fig. 1, at the mean.

The last two columns give a general approximate formula for S.D. and mean.

As the difference between mode and median rapidly approaches a constant value 0·065, the skewness for large multiples is given approximately by $-0{\cdot}138\ r^{-\frac{1}{5}}$.

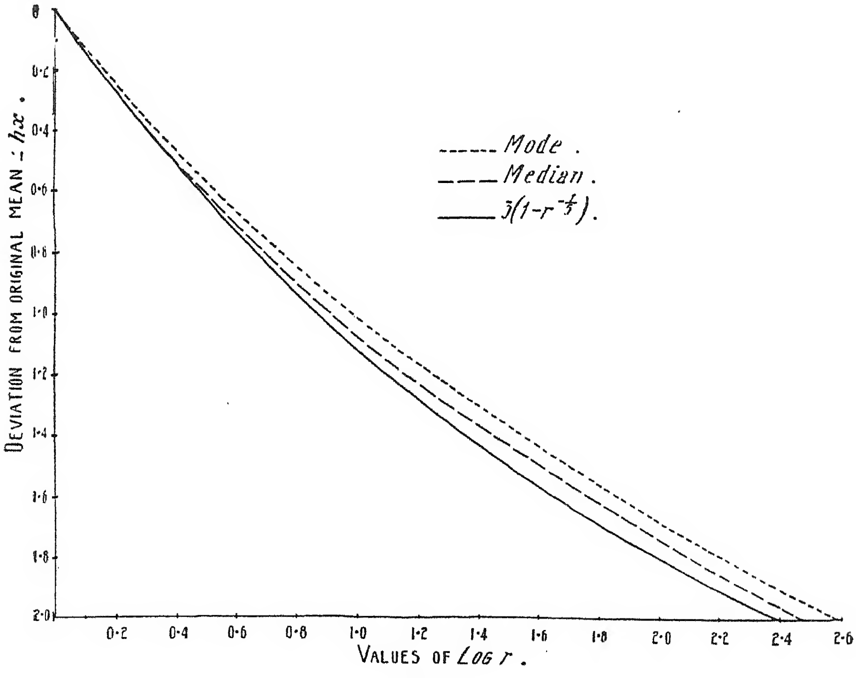

Fig. 3

*Since this was written, a paper[4] has been published with a very detailed table of the range between the extreme individuals of samples taken from a normal population. From Table X., *loc. cit.*,[4] the values given in this table can easily be calculated to six significant figures. The tables agree closely though obtained independently by very different methods. Table I.[4] also shows that the approximation to the S.D. is very satisfactory.

If the curves remained normal, the standard deviation would be inversely proportional to the height of the curve. Owing to the introduction of skewness the spread is somewhat greater, and it is better and sufficiently accurate to take the ordinate at the mean as the measure of S.D. The skewness is then given by—

$$\mathrm{Sk} = \frac{3}{\sqrt{2}} \cdot \frac{\text{median} - \text{mode}}{y_r \text{ at mean}}$$

the median and mode being given by deviations below the original mean in terms of $1/h$.

From the curves $r = 10$ and $r = 100$, the mean and S.D. were calculated from the ordinates at intervals $hx = 0{\cdot}05$, as from an experimental curve, giving values, expressed as in Table II., for the mean 1·087 and 1·769, for $\sqrt{2} \times$ S.D. 0·605 and 0·441, and for skewness $-$ 0·189 and $-$ 0·288, respectively.

The mean for the curve $r = 2$, may be obtained by an independent argument, assuming normal distributions. Suppose a length $2nl$ be tested in $2n$ lengths of l, and alternatively in n lengths of $2l$. Let f be the strength of the weaker of a pair of lengths l, f' of the stronger.

$$\text{The mean of the } 2n \text{ lengths} = \frac{\Sigma f + \Sigma f'}{2n},$$

$$\text{of the } n \text{ double lengths} = \frac{\Sigma f}{n} = \frac{2\Sigma f}{2n}.$$

$$\text{The difference of the means} = \frac{\Sigma(f' - f)}{2n}$$

$$\text{In a normal distribution } \sqrt{\frac{\Sigma(f' - f)^2}{n}} = \sqrt{2} \,.\, \sigma$$

where σ is the S.D. for the single lengths, and f and f' are any two values taken at random, also the mean absolute difference is $\sqrt{2/\pi}$ times the root mean square difference, or

$$\frac{\Sigma\,(f' - f)}{n} = \frac{2\sigma}{\sqrt{\pi}}$$

$$\therefore \text{ The decrease in mean strength} = \frac{\sigma}{\sqrt{\pi}} = 0{\cdot}565\,\sigma = 0{\cdot}399/h.$$

The above values for the mean when $r = 2$, 10, and 100, agree within a fraction of 1% with those calculated from the mode and median, which may be accepted for all the values of r. The argument for double lengths shows most simply the fact that the loss in strength is determined by the differences within the multiple length, the "internal" variability of long specimens, and that the changes in strength and regularity will be less than those calculated from the variability of a large batch of short specimens, when, as in cotton yarn, consecutive lengths tend to be more similar.

In practice it is most convenient to express the changes in terms of the mean and standard deviation. If a_l be the mean from lengths l, σ_l the standard deviation, then—

$$a_l - a_{rl} = v_r \,.\, \sigma_l \qquad (5)$$

$$\text{and} \quad \sigma_{rl}/\sigma_l = u_r \qquad (6)$$

where v_r and u_r are independent of the variability and are known functions of the multiple r, if the curve for lengths l be normal. It is not practicable, from the irregular frequency curves actually found from yarn, to determine whether the shorter length gives a normal curve nor to allow for skewness if present. To obtain a general expression for the effect of length on strength, small changes in v_r and u_r due to skewness must be ignored and simple relations between them then appear. For, from (5) and (6)

$$a_l - a_{rsl} = v_{rs} \, . \, \sigma_l \qquad (5a)$$

and $$\sigma_{rsl}/\sigma_l = u_{rs} \qquad (6a)$$

Also $$a_{rl} - a_{rsl} = v_s \, . \, \sigma_{rl} \qquad (5b)$$

and $$\sigma_{rsl}/\sigma_{rl} = u_s \qquad (6b)$$

$$\therefore \quad a_{rl} - a_{rsl} = (v_{rs} - v_r) \, \sigma_l$$

and $$\sigma_{rsl}/\sigma_{rl} = u_{rs}/u_r$$

Whence $$v_s \sigma_{rl} = (v_{rs} - v_r)\sigma_l \quad \text{and} \quad \frac{\sigma_{rsl}}{\sigma_{rl}} = \frac{u_{rs}}{u_r}$$

or $$v_s = \frac{v_{rs} - v_r}{u_r}$$

and $$v_{rs} = v_r + v_s \, . \, u_r = v_s + v_r \, . \, u_s$$

$$\therefore \quad \frac{v_r}{1 - u_r} = \frac{v_s}{1 - u_s} = \text{constant} = c$$

or $$v_r = c \, (1 - u) \qquad (7)$$

But $u_{rs} = u_r \, . \, u_s$, whence by continuing to factorise r and s comes the relation that u for any value of r is equal to the product of u for the factors of r, or to the nth power of u for the nth root of r.

$$\therefore \quad u_r = u_e^{\log_e r} = r^b \text{ where } b = \log_e u_e \qquad (8)$$

and $$v_r = c(1 - r^b); \quad u_r = r^b \qquad (9)$$

The values of c and b from the values given in Table II. change slowly with r concurrently with the increase of skewness, but a sufficiently good approximation is given by the values 3 and $-\frac{1}{5}$ respectively, when the change of mean is expressed in units $1/h$, or 4·2 and $-\frac{1}{5}$ in Equations (5) and (6), and 5·3 and $-\frac{1}{5}$ when calculating the effect from the mean deviation of the shorter lengths. The values given by this general formula, *vide* Table II., are as close as the assumption of normal distribution for an empirical frequency array warrants.

SKEWNESS

It has been shown that if the strength of specimens of any given length varies according to the normal law, then the frequency curve for longer specimens is negatively skew or, in general, strength distributions cannot be expressed by a normal or symmetrical frequency curve. The argument remains unaltered for any quantity of which the value for a specimen is determined by the minimum value occurring among its elements. By simply subtracting each value from a large fixed value, it is seen that positive skewness is necessarily introduced into the distribution of any quantity determined by a maximum value among the elements of the specimen, e.g., the thickness of cloth measured between plates without compression. To a less degree, but sufficient to make the normal law theoretically inapplicable, skew distributions will be found whenever the deviations of individual values are affected unequally by equal deviations of opposite sign among the constituent elements of a specimen, e.g. the torsional rigidity of rods or the bending moments in bars.

This class of quantity is so large and important that it is highly desirable to reproduce (1b) with an algebraic type of curve. As it is derived from the normal curve, the type to suggest itself is

$$y = e^{-h^2x^2} \ (a + bx + cx^2 + \ . \ . \ .). \qquad (10)$$

Some attempts were made to obtain analytical expressions for the constants of such a formula by fitting it at the median, mode, and original mean, but even with one or two terms only, the result is a complicated implicit function for the decrease of mean. The curve for long specimens, say $r = 100$, is closely imitated by

$$y = y_0 x^{-p} \, . \, e^{-r/x} \qquad (11)$$

Elderton[2] gives this curve fitted to mortality-age figures and it is not unreasonable to connect up such statistics with the above analysis by supposing death to result from the failure of the weakest of a number of bodily functions, the potential life of each varying in a normal manner. There does not seem, unfortunately, to be any algebraic expression for curves of type (1b) comparable in simplicity with the normal law.

The skewness, like the drop in strength, depends on the "internal" variability. If this be small compared with the variations between individuals due to their different origin, the skewness will be negligible or determined by the nature of the production. The distribution of strength of cotton hairs from a commercial sample does not show systematic skewness, being governed by the large differences between individuals due to differences in growth, these fitting into the criterion for normal distribution, that "the deviations be constituted by the summation of a very large number of independent deviations."[5]

In the case of cotton yarns, the element of length is that which is just too great to be spanned by a cotton hair. For specimens a few inches in length, the strength distribution should be unaffected by the skewness due to "internal variability" and be governed by the nature of production. This does not obey the normal criterion as the number of hairs per section gives a positively skew array, owing to the tendency of bunches of hairs to remain together in drafting. Moreover, twist runs into thin more than thick places, so that the strength increases with fibre number to a power lower than unity, which also tends to introduce positive skewness.[3] Very short specimens should therefore give more or less positively skew distributions. Andrews and Oxley[1] have found the skewnesses $+ 0{\cdot}085$ and $+ 0{\cdot}173$ from two sets of 5,000 observations on 3 in. lengths. With longer specimens this skewness should decrease to zero and become negative. Specimens of 12 in., tested by pendulum and Moscrop testers, show no systematic skewness which agrees with theory, the skewness for $r = 4$ being $- 0{\cdot}128$.

LOCAL TENDERING

In tests of tendering by wear and by light, a portion of each specimen is often exposed, the remainder being unaltered. The effect cannot then be strictly estimated by comparing the strength of untreated and treated specimens as the original strength of the tendered portions would be that of the partial, not the whole, length.

Let the total length of specimen be rl, the length tendered l, $\varphi(f)$ the frequency function of strength for untendered lengths l, $\varphi'(f)$ of tendered

lengths. The strength distribution of untendered lengths rl is as before given by Equation 1. For lengths rl, of which a portion l has been tendered,

$$y'_r = \varphi'(f)\left[\int_f^\infty \varphi(f)\,.\,df\right]^{r-1} + (r-1)\,\varphi(f)\left[\int_f^\infty \varphi(f)\,.\,df\right]^{r-2}\int_f^\infty \varphi'(f)\,.\,df \qquad (12)$$

This is a rigorous and general expression which may be greatly simplified for practical purposes if the tendering is large enough to localise the breakages. In this case the apparent tendering is $(a_r - a_1')$ and the real tendering—

$$\begin{aligned}(a_1 - a_1') &= (a_r - a_1') + (a_1 - a_r)\\ &= (a_r - a_1') + v\sigma_1\\ &= (a_r - a_1') + \frac{v}{u}\cdot\sigma_r \qquad (13)\end{aligned}$$

As the effective value of σ in yarn may be rather less than that calculated in the usual way over a large batch, the value of r should be kept as small as possible to minimise the correction. A practical and simple correction of $(+\, v\sigma_r)$ would be in accord with the theory and with the experimental results shown in Table I., Paper I.

COMPOSITE SPECIMENS

Actual specimens are never mathematical units of homogeneous properties, but may be regarded as built up of elements both of length and cross-section. The relation between the strength of elements of length and of long specimens has been derived; that between elements of cross-section and the composite specimen is of a more complicated nature. The problem is involved in the strength of leas of yarn, of a yarn in terms of fibre strength, of a fabric in terms of yarn strength, of electric wire flex, of silk threads, and even of a wooden or metal bar if the cross-section be regarded as constituted of parallel elements.

The relation between the strength of the elements and of the composite specimen depends on the variations of tension and of limiting extension among the strands. Actual conditions may be approximated to by one of several mathematically definite cases.

Case (*a*)—Strands gripped at the ends, of equal original length and uniform breaking extension. However variable the breaking load of single strands, the maximum load on the specimen will be taken just before any strand breaks and will be the sum of the breaking loads of all the strands. As a lea test, this would give a constant 100% "lea ratio," but the conditions are not nearly realised in practice, depending on a very unlikely characteristic of the threads, and this ideal furnishes a most unsound basis for analysis of the test.

Case (*b*)—Strands gripped at the ends and under uniform tension. This case is approximated to in a lea test if the ratio of load to extension is very regular, particularly if the lea is wound under a high uniform tension. The load on the specimen F is $(N - n)f$, where N is the total number of strands, n the number broken, f the tension on each strand. If the frequency curve for single-strand breaking load be $y = \varphi(f)$ and N be large,

$$\frac{N-n}{N} = \int_f^\infty \varphi(f).\ df \qquad (14)$$

$$\text{and}\quad \frac{F}{N} = f\int_f^\infty \varphi(f).\ df \qquad (15)$$

F is a maximum when $\dfrac{dF}{df} = 0$, or

$$\frac{1}{N} \cdot \frac{dF}{df} = \int_f^{\infty} \varphi(f) . df - f\,\varphi(f) = 0 \qquad . \quad (16)$$

The tension on each unbroken strand at the maximum load is f or $(a + x)$ where—

$$f = \frac{1}{\varphi(f)} \int_f^{\infty} \varphi(f) . df = \frac{N - n}{Ny} \qquad . \quad . \quad . \quad (16a)$$

for an empirical frequency curve, or

$$h(a + x) = \frac{1 - \Phi(hx)}{2} \cdot \frac{\sqrt{\pi}}{e^{-h^2x^2}} \qquad . \quad . \quad . \quad (16b)$$

for the normal curve. The ratio of the strength per strand to the mean single-strand strength is then—

$$\frac{F}{Na} = \frac{f^2 \varphi(f)}{a} = \frac{N - n}{N} \cdot \frac{f}{a} \qquad . \quad . \quad . \quad . \quad (15a)$$

for an empirical curve,

$$= \frac{1}{\sqrt{\pi}} \cdot \frac{h^2(a + x)^2}{ha} \cdot e^{-h^2x^2} \qquad . \quad . \quad . \quad (15b)$$

for the normal curve. The proportion of unbroken threads is—

$$\frac{N - n}{N} = f\varphi(f) = f . y \qquad . \quad . \quad . \quad . \quad . \quad (14a)$$

for an empirical curve,

$$= \frac{h(a + x)}{\sqrt{\pi}} \cdot e^{-h^2x^2} \qquad . \quad . \quad . \quad . \quad . \quad (14b)$$

for the normal curve.

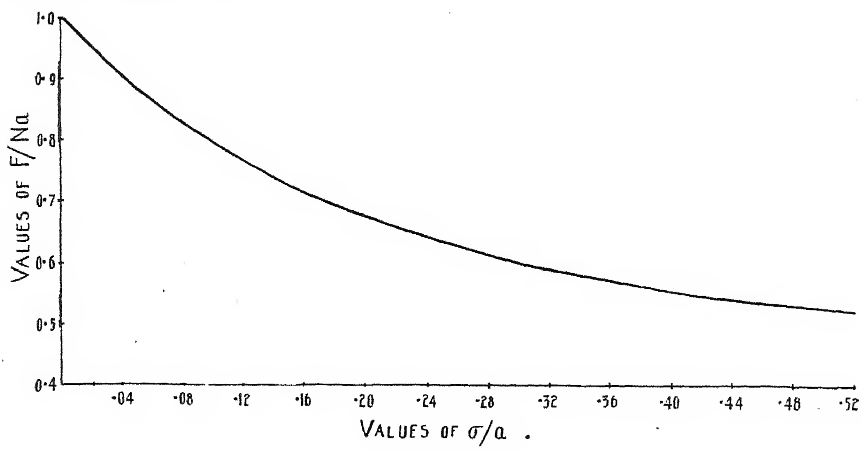

Fig. 4

These equations apply to a continuous frequency curve strictly only when all strength intervals are equally represented in the specimen. The mean breaking load of a number of specimens of finite size will vary about a mean somewhat greater than that given by (15b). This relation, expressed

in terms of the standard deviation, is shown graphically in Fig. 4. Slight differences of tension among the strands may be allowed for by corresponding changes in breaking load, i.e. by adjusting the value of h.

Case (c)—Gripped strands originally of the same length. The extension e of the strands at any moment is uniform, the number of unbroken ends is

$$\frac{N-n}{N} = \int_e^\infty \varphi(e).\,de \qquad (17)$$

where $\varphi(e)$ is the frequency distribution of breaking extension.

The force on the specimen will be affected by any correlation between breaking extension and the load-extension ratio for single strands. Tests made on the Shorter instrument on 45 threads of 36's Sakel yarn (Paper III.) showed that the mean ratios for the survivors after no breaks, the first five lowest extensions, the second five, &c., were ·773, ·770, ·764, ·761, ·760, ·756, ·762, ·769, ·755. It is accurate enough to use an unvarying mean ratio of load to extension, $E = f/e$, when—

$$\frac{F}{N} = E.\,e.\int_e^\infty \varphi(e).\,de \qquad (18)$$

Then F is a maximum when—

$$e = \frac{1}{\varphi(e)}\cdot\int_e^\infty \varphi(e)\,de \qquad (19)$$

and the ratio of strength per strand to mean single-strand strength is given by substituting this value in the formula.

$$\frac{F}{Na} = \frac{E}{a}\cdot e^2\,\varphi(e) = \frac{e^2}{\bar{e}}\cdot\varphi(e) \qquad (18a)$$

This result is identical with the foregoing, except that the frequency curve of breaking extension is substituted for that of breaking load. The decrease in strength per thread for cases (b) and (c) can be found from Fig. 3. Case (c) probably gives the nearest simple approximation to a large number of physical cases, including the lea test, when the threads are gripped so tightly that they do not slip when neighbouring threads break.

Case (d)—Strands maintained at uniform tension and all slip when one breaks. This is realised when a long continuous thread is wound over hooks or pulleys incapable of maintaining differences of tension. The case is fully covered by the formulæ for long specimens.

Case (e)—Strands of uniform original length uniformly extended (gripped) till one breaks, when all slip. This bears the same relation to (d) that (c) does to (b).

The breaking extension is the minimum value among the individual strands and is given by formulæ mathematically identical with those for the breaking load of a long specimen.

If e_r be the mean breaking extension of a specimen of r strands, S_r the standard deviation,

$$e_r = e_1 - vS_1 \text{ and } \frac{S_r}{S_1} = u \qquad (20)$$

The mean ratio of load to extension E may be taken to a first approximation as constant for its variability decreases as $r^{\frac{1}{2}}$ against $r^{\frac{1}{5}}$ for the breaking extension of the whole specimens. Then—

$$E\,e_r = E\,e_1 - vES_1$$

$$\text{or} \quad a_r = a_1\left(1 - v \cdot \frac{S_1}{e_1}\right) \qquad . \quad . \quad . \quad . \quad . \quad . \qquad (21)$$

$$\text{and} \quad \frac{\sigma_r}{a_r} = \frac{S_r}{e_r} = \frac{S_1 u}{e_r} = u \cdot \frac{e_1}{e_r} \cdot \frac{S_1}{e_1}$$

$$\text{or} \quad \sigma_r = u \,.\, E \,.\, S_1 \qquad . \quad . \quad . \quad . \quad . \quad . \qquad (22)$$

Equation (22) is approximate in so far as it neglects the variability of E which may be appreciable on specimens of a small number of strands. To take it into account would involve consideration of the correlation between E and e, and the complication is not justified as the equation is nearly true even for $r = 1$, the variability of load being of the same order as that of extension.

THE LEA TEST

When a lea of yarn is wound and tested without particular care, a rough approximation is made to case (*c*) and case (*e*), varying between them according to adventitious circumstances. If the ends be clamped the approximation to case (*c*) is improved, but the difficulty of obtaining uniform initial tension and of avoiding tearing is so great that actually the results are lower than without clamping. The case is, moreover, much less simple than case (*e*) in correlating with single-thread properties.

If a thread is led over a number of light well-mounted pulleys, a close approximation to case (*d*) is obtained which gives the simplest possible relations, but the method could hardly be applied to more than a few turns. If wound over the usual hooks to a fewer number of turns than a whole lea, and carefully placed so that the threads do not interfere with each other, and if loaded so slowly that the threads can slip without increase of load at the first break, then the conditions are very accurately those of case (*c*), and the relations simple and of useful significance.

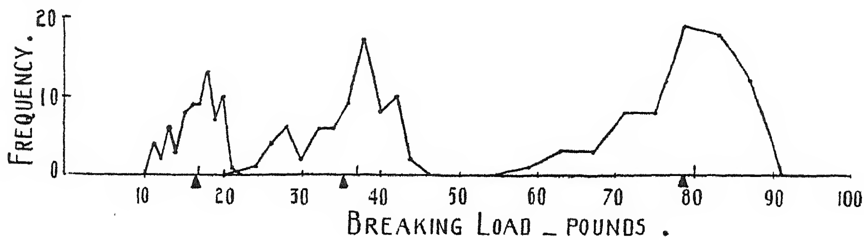

FIG. 5

The friction between threads and hook allows a ratio of tensions of 1·6 between the two sides (Paper I., Appendix 1). This does not allow any material differences of tension at the beginning of loading and the threads slip slightly to adjust any unevenness. The tension developed in stretching varies according to the ratio of load to extension. From the Shorter diagrams of 36's Sakel yarn referred to in case (*c*), the standard deviation of this ratio is 6·4% of the mean. The probable difference of tension between two adjacent threads is then 6·1%, and the probability of differences of 60%

over the tension developed in even the most extensible threads is vanishingly small. The suggested modification of the lea test is therefore a very close realisation of case (*e*).

Negative skewness is introduced by the conditions of this case to the same extent as for long specimens, that introduced by a multiple of 160 being 0·334. The frequency polygons for the strength of 72 leas, half-leas, and quarter leas of 60's West Indian yarn wound off a cheese are shown in Fig. 5. The skewnesses, calculated from the mean and median, are respectively − 0·565, − 0·906, and − 0·463, and, furthermore, they approximate to a smooth curve of the type derived analytically (Fig. 1).

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33—THE LEVELNESS OF MULE YARNS

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In a paper, "A Gravimetric Method for Investigation of the Variation of Levelness of Yarn" (*J. Text. Inst.* 1926, **17**, T259), S. G. Barker, discussing the subject of the mule draw, says, "In the case of cotton, Oxley found a maximum thickness at the end of each draw, or approximately 70″ apart."

This statement is incorrect, on Barker's assumption that "thickness" is determined by the gravimetric test. The regularity tester measures the diameter of a yarn under a suitable load, and this diameter is primarily dependent on twist hardness, which is definitely periodic, and secondarily on the counts. It would appear that Barker can hardly have recognised the difference between counts and photographic regularity tests as detailed in *J. Text. Inst.* 1922, **13**, T54. Though the roving delivered by the rollers may be such that the bulk of cotton in each element of the stretch is perfectly constant, yet the twist period will persist, those elements of yarn nearest the spindle tip having an unduly high twist and appearing thin to the eye. These thin pieces of yarn give a maximum on the trace of the photographic regularity tester, owing to their greater resistance to compression. Such a yarn, ideal as it may be, judged by a counts test, may give rise to the fabric faults of barring and steepling already well-known and no finishing process can eradicate them. The periodic variation of *twist* was amply confirmed on the oscillating stress tester (*J. Text. Inst.* 1923, **14**, T18).

Barker apparently considers that levelness of yarns can be satisfactorily interpreted in terms of *bulk of cotton*, ignoring completely variations of twist. It should be clearly emphasised that this is not the case and that the maxima of thickness which he mentions are not directly connected with any maxima referred to in work with the regularity tester.

It should also be pointed out that the gravimetric method is by no means original; for counts tests on regularity were made four years ago on yarn specimens 1 in. long, to investigate the inverse correspondence of twist and fibre numbers (*J. Text. Inst.*, 1922, **13**, T172, Plate I., and *J. Text. Inst.*, 1923, **14**, T23, Plate IV.), and not only were thousands of these short specimens weighed on a micro-balance, but the number of fibres in each was counted. As will be seen from a perusal of the papers referred to, the inverse correspondence of twist and fibre number holds roughly, except for those elements of the mule yarn which were near the spindle tip in the draw. This periodic twist is a serious lack of levelness which no counts test will disclose. In short, although the counts, inch by inch, are uniform it does not follow that the yarn is satisfactory for trade purposes. Other tests are necessary.

Lastly, the statement on p. T259, that in the regularity tester "the yarn was drawn between a metal shoe and a *flat plate*" is incorrect. It seems desirable to point out these mis-statements, since they imply a false interpretation of the results published so long ago as February 1922.

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2nd July 1926

34—THE BLEACHING OF WOOL WITH SULPHUR DIOXIDE

A SUMMARY OF THE LITERATURE

By E. F. H. Cook

(The British Research Association for the Woollen and Worsted Industries)

INTRODUCTION

If wool is treated with sulphur dioxide, washed with water, and subsequently reoxidised, it will be found to have undergone certain changes. The natural colouring matter of the wool which is insoluble in water has been reduced, and with the SO_2 forms a water-soluble, colourless leuco compound, which has to be washed out well if the bleach is to be fairly permanent. The process is called "sulphuring," and is the oldest and cheapest method of bleaching wool. It was already practised in the Middle Ages on very much the same principles as it is to-day, and no operation in bleaching has changed so little during the centuries. According to the form in which the SO_2 is applied, either in the form of gas or dissolved in water, one can distinguish between "gas bleaching" and "liquid bleaching," and of these two methods the former is more generally employed.

With regard to the results obtained with either method, it may be said that neither sulphur fumes nor the liquid give a really genuine bleach. The sulphur whites are all more or less unsatisfactory because they are not permanent. The oxygen of the air reoxidises them back to their original condition, an action which is greatly hastened by moisture, sunlight, and air. (It will be noted that the fact that the colour returns does not agree with the statement that the leuco compound must be or can be washed out. Raynes[24a] shows that dry wool forms a yellow compound with SO_2; this may explain the discrepancy.) The rough and harsh handle which the sulphur imparts to wool, and the smell of it, which is extremely difficult to eradicate from the goods, are further disadvantages of the sulphur bleach.

Many of the processes described involve the use of oxidising substances (e.g., permanganate) either before the SO_2 or after to remove the excess. There seems to be little evidence of advantage in these more elaborate methods.

TECHNICAL APPLICATION

The Gas Method

The wool is well scoured to free it from soap and grease, exposed to the gas for from 6-24 hours, according to requirements, then aired and rinsed, treated with oxidising agents if necessary, and again rinsed in water. The foregoing is a general outline of the process, but a number of good descriptions of the same will be found in current text-books, [7, 8, 9, 21, 25, 36, 37], which differ only slightly in details of mechanical equipment or length of exposure to the gas.

The bleaching action of sulphur dioxide on the wool is explained by Bottler[2] in the following way—A colourless compound forms between the colouring matter of the wool and the dioxide, and is removed by washing, as it is liable to undergo decomposition after a time, thus causing the wool to resume its natural colour. He attributes the harsh handle of wool not

to sulphuring, but to rinsing in impure or hard water. Cooper[4] is of the opinion that the SO_2 in some cases decomposes the water present, liberating hydrogen, which in its turn reduces the coloured body.

According to Beech,[1] the gas method is not an effective process, as the colouring matter is not destroyed, but only enters into a chemical combination. Another defect, he states, is that the sulphur volatilises, settles upon the wool, and turns it yellow. To restore the suppleness of the wool, which sulphur bleaching leaves rather hard, the author recommends washing in weak soft soap or soda, care being taken that the alkaline treatment is not so strong as to neutralise the bleaching effect.

Hummel[12] considers that the bleaching action of sulphur dioxide is most probably due to its reducing action upon the natural yellow colouring matter of wool, or perhaps to the formation of a colourless compound with the latter. But the effect is not permanent. Frequent washing in alkaline solution tends to restore the yellow colour of the fibre, which is to be explained according to Hummel[12] in the following way—it either induces oxidation or the colourless bisulphite compound is decomposed and the original colouring matter is precipitated on the fibre.

Meister, Lucius & Brüning[20] point out the disadvantage of the sulphur bleach of only transforming the yellow of wool temporarily into a colourless body, and of acting destructively on many colours if all traces of sulphur dioxide are not removed, but they consider it to be cheaper and easier to operate than any of the oxidation methods. They further state that sulphur whites change their shades considerably in the subsequent processes of milling and steaming if Methyl Violets have been used for tinting.

Heermann[11] is of the opinion that on the whole the gas method is not supposed to be so thorough as the liquid process, but where the gas comes properly into contact with the fibres, it is more effective than the solution. He, too, advocates clean and if possible soft water, as unsuitable water gives wool a harsh handle. To prevent this harshness, he applies a weak soap bath before sulphuring, and adds soda or soap to the rinsing water to neutralise the acid, and at the same time remove the reaction products of the wool dyestuffs. This is especially important as bleaching has only converted the colouring matter into a leuco compound and not destroyed it.

In connection with the effect of sulphur dioxide on wool it is interesting to note Matthews'[17] observation, that besides giving the fibres a harder and rougher handle, it lessens their lustre. He, too, points out the difficulty of removing SO_2 from wool, but thorough washing with iron-free water, or in some cases weak baths of chloride of lime, sodium hypochlorite, potassium permanganate, or hydrogen peroxide should free the fibre from it and restore the pleasant handle. Of these oxidising agents he believes hydrogen peroxide to be the safest. It converts the SO_2 into sulphuric acid, which is easily removed by washing, and, further, there is no danger of an excess injuring the fibre. Chloride of lime, although it neutralises the injurious effect of sulphurous acid, and also increases the affinity of wool for many dyestuffs, gives injurious results if all the chemical is not subsequently removed. In another of his books Matthews[18] discusses the practical impossibility of removing every trace of sulphurous acid by washing, however thorough it may be, as the wool apparently combines chemically with it. Sulphurous acid, he states, holds the pigment in the fibre in a reduced state so that the bleach lacks permanency, and, further, the

presence of sulphurous acid is liable to act injuriously on other colours with which the wool may subsequently come into contact.

Numerous secondary effects of the stoving process are discussed by Schofield,[30] who maintains that some SO_3 is formed at the same time, which combines with the moisture to form sulphuric acid in the fabric, and the concentration of this acid during drying may deteriorate the material.

Ristenpart and Herzfeld[27] allow sulphur dioxide to act on the wool overnight and longer, and especially point out that the goods must be moist, as the dry gas does not bleach. Matthews[18] makes a statement to the same effect, that the wool should be moist, not wet, as the gas only acts slowly on dry wool. He exposes the material to the gas for 10-20 hours. Walland[34] in his description of the gas bleaching method, advocates the presence of sufficient oxygen in the sulphur chamber, otherwise the sulphur dioxide is mixed with sulphur fumes, which condense in cool places and form yellow stains.

According to Bottler[3] the bleaching operation lasts from 6-8 hours, and if necessary is repeated two or three times. Treatment with a warm solution of soda and soap then follows, which removes the excess of acid and (he says) also the converted colouring matter. It also makes the wool supple and soft. This author further remarks that although the soda gives wool again rather a yellowish tinge, this can be removed by sulphuring and washing once more.

With reference to the use of potassium permanganate for oxidising purposes, Matthews[18] recommends great care not to employ an excess beyond that which is necessary for the reaction, otherwise a brown deposit of an oxide or hydrate of manganese will form on the wool. Subsequent treatment with sodium bisulphite, he states, again removes this deposit. Knecht, Rawson, and Loewenthal[15] counteract the small amount of yellow which remains in the wool after stoving, by blueing or tinting with a colour complementary to yellow. A similar method is recommended by Meister, Lucius & Brüning,[19] who pass the wool through a weak soap bath, which for special shades is tinted with suitable blue or violet colours. The bleached material must not be dried at too high a temperature.

Sulphur Stoves &c.

Much of the plant in use to-day is still very primitive. A chamber of four walls and a pan in the corner upon which the sulphur is burnt, constitute the whole equipment, and although newer stoves are better constructed, they still adhere closely to the old system. The most notable modification is that the sulphur is sometimes burnt in a separate compartment, the gas being led or driven by a fan into the bleaching chamber.

An example of this type of generator is the Clayton; the air and gas is continually circulated from the bleaching chamber through the burner and back to the chamber. In this manner a greater concentration of gas is obtainable, and the concentration is easily controlled.

Hummel[12] describes a stove of the above old style, and one in which the operation is made continuous for thinner materials. The latter is provided internally with a wooden frame, having rollers above and below. The roof is lined with lead and heated with steam pipes to prevent condensation. The stove is charged with sulphur dioxide by burning the sulphur inside or preferably outside, and leading it in underneath a false perforated floor. The cloth is introduced through a narrow slit in the wall, passes

under and over the rollers and out again by the same opening. A similar stove is also described by Beech.[1] Further technical details of sulphur stoves are given by Paterson,[22] who holds that they require to be spacious, although not too roomy, in order to give free access to all parts of the yarn, so that full advantage may be taken of the sulphur consumed. If the chambers are built of brick, the walls must be lined with wood, as SO_2 so acts on the bricks and lime as to disintegrate them in time. He also recommends special attention to the heat of the ball used for igniting the sulphur, and the proper admission of air into the chamber. Zänker[37] describes a stove only differing from the above in that the gas is passed underneath the roof instead of the floor. According to the size of the chamber, two, three, or more sulphur pans are used, so that the sulphur does not sublimate, but burns completely. A vessel containing water should be placed inside the chamber to produce the necessary moisture. Bottler[3] recommends passing wool fabrics &c., which are to be bleached, slowly through the sulphur stoves instead of hanging them up, and describes a stove with ventilation holes, which open and close automatically with the varying pressure. By covering the sulphur pans with a lead-coated shield and a piece of felt, sulphur is prevented from settling on the goods.

A good illustration of a continuous sulphur stove is given by Reiser.[25] It really consists of four chambers—(1) containing the sulphur pan, (2) a chamber where the sulphur fumes are distributed and pass through an opening into (3), the actual sulphur chamber, at each side of which are continuously rotating rollers, and (4) a ventilator. In some sulphur stoves the motion of the goods is not a horizontal but a vertical one, and in the latter case the fumes rise to the top and are distributed more easily.

It may be noted that when a continuous fabric is to be treated the method of passage over rollers offers advantages. If also one of the methods of recirculating the chamber gases through the burner be used, thus obtaining a high concentration of gas, then the time necessary for treatment may be very brief.

Matthews,[17] in his detailed account of various forms of bleaching chambers emphasises the necessity of providing suitable means of ventilation and heating coils to prevent drops of condensed acid forming on the roof. The presence of metals in these rooms should be avoided, as acid vapours forming therein will rapidly attack them, and the products dropping on the wool will cause stains. He further describes a convenient apparatus devised by Shaw for bleaching wool materials with compressed sulphurous acid gas in an airtight vessel, where it is supported on a perforated beam. It consists of a cylinder containing the liquid sulphurous acid which is connected to an expanding chamber. This in turn is connected with a cylinder through which a perforated pipe leads up through the material to be bleached. The air having been exhausted from the expanding chamber, sulphurous acid is admitted until a pressure of about one atmosphere is attained. Shaw also describes this same apparatus in his patent (1901).[32]

In some old patent specifications the gas method of bleaching wool &c. is described as follows by Dale and Dale (1866).[5] The fabrics are placed in an airtight vessel into which sulphurous acid produced by burning sulphur in air or by heating sulphuric acid and charcoal, is introduced either alone or mixed with steam. Piece goods may be wound on a perforated pipe, and the sulphurous acid forced through them, either alone or mixed with

steam, or water may be supersaturated with sulphurous acid and used instead of the gas. Sachs (1876)[28] patented the following procedure. Wool after washing with a weak solution of chlorine is treated with a solution of potassium permanganate, and then subjected to the action of sulphur vapours in a closed chamber. The materials are then washed with a weak alkaline solution. In some cases a small quantity of magnesium sulphate is added to the permanganate solution. A patent taken out by Margotin (1909)[16] describes an apparatus and means of preventing alteration in the fibre, or the production of yellow stains, due to the action of the air, and also to avoid the escape of SO_2 into the atmosphere. In addition to the usual closed vessel this comprises—(1) The driving of SO_2 out of the vessel into water or an absorbent solution of soda or lime by compressed air; and (2) prior treatment with a solution of potassium permanganate, hydrogen, or other suitable peroxide, to prevent any harmful action by the compressed air.

The Liquid Process of Bleaching

For this purpose aqueous sulphurous acid or sodium bisulphite solution are usually employed, and bleaching by means of the liquid method is considered to be as powerful as bleaching with sulphur dioxide gas. The goods are worked and steeped in a bath containing bisulphite of soda, sulphuric or hydrochloric acid, and *iron-free* water, treated with oxidising agents and tinted with alkali violet or some other colour. If the whites are required to withstand milling, the use of indigo in the bleaching bath or afterwards is advisable. In a paper on bleaching with sulphurous acid or bisulphite of soda (*J. Soc. Dyers and Cols.*),[38] the suitability of both agents for the purpose are compared, and the bisulphite of soda is considered to be more suitable, as it dissolves the brown shade of manganese oxide from the fibre more easily.

The whites obtained with the liquid method are not more permanent than those produced by sulphur dioxide, but a better clearance of the sulphur smell is possible (*Text. Rec.*).[39] Matthews,[17] however, is of the opinion that although the whiteness produced by the liquid process is of the same degree as that obtained with the stoving method, it is more permanent, and when dry the wool is free from the smell of sulphur. The writer assumes that this greater permanency of the white is probably due to the better penetration of the bleaching agent into the core of the fibre.

Liquid bleaching is not any more perfect than gas bleaching, according to Beech,[1] as the colour is liable to return on washing with soap or alkalis. It is, however, free from the defect of producing yellow stains. Paterson[22] considers the wet process to be the best theoretically, but the bleaching action seems to take longer than by the gas method. Zänker[37] and Murphy[21] both state that the liquid bleaching method is generally preferred to the SO_2 method, especially for piece goods, as a better control during the process is possible. Meister, Lucius & Brüning[19] find that the shades are not as pure as those obtained by bleaching in sulphur chambers.

Details of the bisulphite process are given by Matthews[17] as follows—The material is steeped for 6-10 hours in a sodium bisulphite bath of about 2° Tw., and subsequently in a bath of sulphuric acid at 1° Tw., which renders the bleaching complete. The whole process lasts from 6-24 hours. Treatment with chloride of lime or other oxidising agents removes the last traces of sulphurous acid. The writer points out the necessity of thorough scouring and hydro-extracting before bleaching, as cloth, if too wet, will not take

up the bleaching liquor properly, and if too dry the bleaching is uneven. Bottler[2] advocates a solution containing sodium bisulphite and hydrochloric acid, the operation being equivalent to bleaching in a solution of common salt saturated with sulphur dioxide. Beech[1], too, recommends a weak hydrochloric acid bath after steeping in a bisulphite solution for one hour, as this liberates sulphur dioxide, which in a nascent condition is more powerful than if it were already free.

With regard to the strength of the solutions to be used, Hummel[12] is of the opinion that bleaching is more effective by leaving the wool in a sodium bisulphite solution of 20° Bé for 10-15 hours, and then immediately treating with sulphuric acid of 4° Bé, than by bleaching in dilute solutions. Zänker[37] uses three baths. A preliminary bath containing potassium permanganate and soda, a bath 2-3% of sulphurous acid or sodium bisulphite of 3°-5° Tw., and a second bisulphite bath or an almost boiling solution of oxalic acid. In an anonymous paper on sulphur bleaching (*Text. Rec.*),[39] it is suggested that by giving the acid bath separately the method is far more effective than by combining it with the bisulphite bath, as then the acid liberates sulphurous acid within the fibres themselves. A recent patent by Griesheim-Elektron claims the use of sodium bisulphite of 0·5 to 1·0 B for 2 to 5 minutes.

According to an earlier patent by Smith (1875),[33] wool is subjected to the successive action of warm oxidising baths, followed by washing with alkaline sulphites and warm or cold liquors of bisulphites or sulphurous acid. After being subjected to the action of dissolving agents or oxidisers, the goods are sufficiently bleached to receive any dye. Sahlström and Parr,[29] in their patent (1892), treat wool successively with a solution of permanganate of potash, air, liquid, or gaseous sulphurous acid, water, and a current of oxygen or ozonised oxygen. Jardine and Nelson,[14] in a more recent specification (1914), bleach textile fibres under pressure with magnesium or sodium bisulphite, the liberated gases being removed in order to prevent deterioration of the fibre by the liberated sulphur dioxide.

Many other accounts of the bisulphite method which only vary in a few details are to be found in current literature by Matthews,[18] Hummel,[12] Knecht, Rawson and Loewenthal,[15] Paterson,[22] Meister, Lucius and Brüning,[19, 20] Walland,[34] Heermann,[11] Bottler,[3] Ganswindt,[9] Schreiber,[31] E. P. Paterson,[24] &c.

Sulphurous acid can also be substituted by sodium hydrosulphite, and Matthews,[17] Bottler,[2] Knecht, Rawson and Loewenthal,[15] Dommergue,[6] *Text. Rec.*,[39] and patent specification Imray,[13] have described processes of this kind. Small quantities of finely ground indigo, thin milk of lime until alkaline, and acetic acid are usually added to the hydrosulphite vat. The indigo is converted into indigo white, and absorbed by the fibres in this condition, the blue colour being regained on exposure to air. Knecht, Rawson and Loewenthal[15] immerse the goods in the above vat for 12-24 hours, while Matthews[17] considers soaking for 6-8 hours in a hydrosulphite solution at about 2° Tw. sufficient. Dommergue[6] points out the necessity of washing and rinsing the wool out of contact with air during the process, otherwise heating takes place and the material is damaged. He further suggests that if the pieces are marked, they should be passed through a bath of dilute hydrochloric acid.

The use of hydrosulphite of soda in conjunction with barium chloride for the purpose of bleaching wool is described by Graham and Cope in their

patent.[10] The goods are bleached by immersing in a solution obtained by treating sodium bisulphite with zinc powder, decanting, and adding barium chloride paste to the liquid, and then washed in potassium permanganate.

Bottler[3] and Zänker[37] give details of the method of bleaching with hydrosulphurous acid as follows—The wool is treated for 12-24 hours in a bath of dilute hyposulphite (3°-4° Bé) and acetic acid, exposed to air, washed and dried.

Wirth (1876)[35] has patented the following procedure—The wool is passed through a bath of indigo, and is then placed in a vat containing hydrosulphite and some acetic acid, air being excluded. The indigo is reduced to indigo white, which on exposure to air becomes permanently blue, neutralising the yellow of the wool. The bath may then be used for a second operation with addition of a further quantity of hydrosulphite. The fibre is taken out and hydrochloric acid added until sulphurous acid gas is given off from the sulphites present. The fibre is replaced and bleaching completed by the sulphurous acid. After-treatment with acetic acid finishes the process. Wirth suggests the use of neutral hyposulphite for bleaching wool of a very yellow colour.

INVESTIGATIONS ON THE CHEMISTRY OF THE PROCESS

On the subject of fixation of sulphur dioxide by wool, during the bleaching process, some interesting investigations have been made by Reychler,[26] from the results of which he concludes that the amount of gas fixed by wool depends partly upon (*a*) chemical combination, but (*b*) mainly upon absorption (solution) of the gas by the fibre.

The following is the method which Reychler[26] used for this determination—The material was placed in a dry atmosphere of sulphurous acid, mixed in various proportions with air. C and c respectively denote the number of molecules of SO_2 per kilogram of wool and per litre of gas. In the case of fat-free wool containing 11·4% of water, the relationship between C and c is given by the equation $C = 0{\cdot}88 + 44{\cdot}7c$, provided c is greater than about 0·005 molecules per litre. When the concentration of sulphur dioxide is smaller than this, the amount absorbed is less than that required by the equation, and the difference between the two quantities increases as the concentration diminishes. This shows that the quantity combined increases first with the concentration, but attains a maximum, represented by 0·88 molecules of sulphur dioxide per kilogram of wool.

Some figures obtained by Raynes[24a] agree fairly well with those of Reychler, but he can find no proof of the presence of a chemical compound in measurable amounts.

Paterson,[23] in his paper dealing with the affinity of wool for SO_2, writes that sulphur dioxide is retained so strongly by wool that drying stoved yarns at 160°-212° F. will not remove it. Yarns wound on bobbins were found to retain SO_2 after 12 years on the inside where it is not exposed. When he exposed sulphured yarns to strong direct sunlight for 10 days, he found that nearly two-thirds of the adsorbed SO_2 changed into sulphuric acid. A sample of ordinary sulphured yarn after heating for four hours to 160° F. to expel the excess of sulphur dioxide, was steeped for 12 hours in cold water and gave up 0·56% sulphur dioxide, but if exposed to sunshine will yield to the water only 0·17%, the rest being in the form of sulphuric acid.

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35—THE BLEACHING OF WOOL WITH SULPHUR DIOXIDE AND SULPHUROUS ACID AND A NOTE ON THE PRESENCE OF A CARBONYL GROUP IN WOOL

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THEORETICAL CONSIDERATIONS

SUMMARY AND CONCLUSIONS

The bleaching of wool by sulphurous acid has previously been attributed to (*a*) the conversion of the colouring matter into a soluble substance, (*b*) reduction to a colourless compound, (*c*) combination to form a colourless compound.

It is shown in the present communication that at least two distinct components of wool combine with sulphur dioxide. The one of these, apparently itself colourless, gives a lemon-yellow product, which may be prepared from nearly dry wool, and is only produced when a high concentration of sulphur dioxide is used; this substance is very unstable, being completely decomposed in a vacuum. This yellow body and this reaction do not seem to be connected with the bleaching effect. It may be suggested that some colourless amino-compound of the wool is converted by combination with sulphur dioxide (possibly only in the presence of a trace of water) into a coloured quinonoid salt, just as colourless amino-derivatives of triphenyl carbinol are transformed into coloured compounds by interaction with acids.

The other component of wool which combines with sulphur dioxide does so only in the presence of appreciable quantities of water, and is possibly a coloured carbonyl compound which gives a colourless additive product

$$>C\begin{cases}OH\\O{\cdot}SO{\cdot}OH\end{cases}$$

This substance is relatively stable in a vacuum, but is very slowly decomposed on exposure to light and air, the wool being then debleached; it is slowly decomposed by prolonged washing with water, and very quickly by alkalis.

The bleaching of wool with sulphur dioxide in the presence of moisture does not depend to any appreciable extent on the reduction of any component by the addition of hydrogen and simultaneous formation of sulphuric acid.

The presence of carbonyl compounds in wool seems to be established by the behaviour of the material towards hydroxylamine and semicarbazide, but from the fact that wool bleached with hydrogen peroxide still reacts with hydroxylamine, it would seem that there are both coloured and colourless carbonyl-compounds in the fibre.

From a very comprehensive survey of the literature dealing with the bleaching of wool by sulphur dioxide and sulphurous acid,* it is clear that

* As facilities were not available in Nottingham for a thorough search of the literature, the British Research Association for the Woollen and Worsted Industries kindly placed at the author's disposal an epitome by Miss Cook of some forty papers and text-books on the subject; the author wishes to express his gratitude for this assistance.

very little is known about the chemical changes which occur in these operations. Some writers (Bottler, "Modern Bleaching Agents and Detergents") suggest that the natural colouring matter of the wool, which is insoluble in water, is converted into a soluble substance, which is removed when the material is subsequently washed. According to Cooper ("Textile Chemistry"), this conversion is due to reduction, involving the simultaneous oxidation of the sulphurous acid, but Hummel ("The Dyeing of Textile Fabrics") suggests that the sulphurous acid combines with the colouring matter to form a colourless product.

From a theoretical point of view, no other suggestions of importance have been made, and any further reference to the original papers or text-books would therefore be of little value; the matters there dealt with concern rather the non-permanency of the sulphur bleach, the relative merits of the dry (gas bleaching) and wet (liquid bleaching) processes, the effect of the treatment on the properties of the wool, and other questions of practical importance, which throw no light on the chemistry of the process.

The first experiments which were made had for their object to ascertain whether any component of wool does or does not combine with sulphur dioxide. For this purpose unbleached wool, dried at 100° C., was treated with dry sulphur dioxide in the absence of air; instead of being bleached, the wool turned a distinct lemon yellow colour, which persisted even after prolonged action. A similar development of colour also occurred when the wool was treated with a sufficiently concentrated solution of sulphurous acid. As it is difficult to conceive that such an intense coloration could be produced by simple adsorption, it must be concluded that chemical combination occurs between the sulphur dioxide and some component of the wool. The yellow compound so formed, however, is most unstable, since, when the coloured wool is placed under highly reduced pressure it regains its original (unbleached) appearance; the same result occurs when pure nitrogen, hydrogen, oxygen, or carbon dioxide is passed over the yellow material, and also when the latter is treated with a sufficient quantity of air-free water. It appears therefore that the yellow additive compound dissociates or decomposes even at ordinary temperatures. It may also be inferred that the yellow compound is not formed from that colouring matter which is rendered colourless in sulphur bleaching; because, whereas both wet and dry wool give the yellow product, the former only is bleached when the sulphur dioxide is subsequently removed under reduced pressure. In other words, the disappearance of the lemon yellow colour is not necessarily accompanied by the bleaching of the wool; whether the latter is bleached or not depends on some other change which has taken place previously, during the actual development of the yellow colour. In order to try and obtain further evidence of chemical combination, very careful experiments were made on the absorption of sulphur dioxide by wool both in the "dry" condition and in the presence of known quantities of water. For this purpose it was necessary to devise an apparatus consisting entirely of glass, because it was found that rubber stoppers and connections absorbed appreciable quantities of sulphur dioxide.

The wool which was employed was first extracted with ether in a Soxhlet apparatus, then thoroughly washed with water at 50° C., extracted with pure alcohol, and dried at 103° C. in a conditioning oven.* For those experiments in which moist wool was used, a known weight of the dried materials was then exposed to moist air or damped with water; from the

gain in weight the percentage of moisture in the product could be ascertained. The absorption experiments were carried out under atmospheric pressure, pure dry sulphur dioxide being used; most of the gas was absorbed during the first ten hours, but not until about twenty-four hours had elapsed was absorption practically complete.

From the results of four concordant experiments it was found that one gram of "dry" wool at 17° and 760 mm. pressure absorbs 55 c.c. of sulphur dioxide. The presence of a small quantity of added water did not make any appreciable difference to the result, but when the wool carries 75-100% of its own weight of added water, the volume of gas absorbed, calculated for one gram of "dry" wool, increased to 90 to 102 c.c From the average value thus obtained in all the experiments it was found that the increased absorption which occurs in the case of the wet wool corresponds very closely with that which should be observed if the additional volume of gas is merely dissolved in the water present. Thus one gram of "dry" wool, plus 0·75 gram of water, absorbs 89 c.c. of sulphur dioxide. But 0·75 gram of water at 17° and 760 will dissolve 35 c.c. of the gas; subtracting this volume from the total, the absorption due to the wool is 54 c.c., a volume almost identical with that obtained with "dry" wool and with wool containing not more than about 2% of additional moisture.

As it is highly probable that the weight of the sulphur dioxide which acts chemically on the coloured components of wool is very small compared with that of the wool, it was not very likely that any conclusions could be drawn from the final results of such absorption values, since even the "dry" wool would contain water sufficient to catalyse chemical action; for this reason the *rate* of absorption was also studied, and at the commencement of each experiment readings were taken at intervals of fifteen seconds, the absorption values being then plotted in the form of curves. It was hoped that in this way some evidence of chemical combination might be forthcoming, but this was not the case; the regular parabolic curves which were obtained showed no initial irregularities such as might be taken to indicate a rapid chemical combination.

Reychler (*J. Chim. Phys.*, 1910, 8, 3) exposed wool containing 11% of water to mixtures of sulphur dioxide and air of varying and known concentrations, and suggested that his results afforded some indication of chemical combination to a maximum extent of 0·88 mol. of sulphur dioxide per kilogram of wool. The author's observations do not substantiate Reychler's suggestions in this respect, although the experimental absorption values are not discordant. Thus the total maximum absorption, chemical and physical, which Reychler observed was 64 c.c. per gram, compared with about 60 c.c. found by the author. The difference between these

* I am informed by the Director of the British Research Association for the Woollen and Worsted Industries that work which has been carried out and is still in progress shows that commercially "dry" wool may still contain from 1% to 2% of moisture. The commercial method of determining "regain" involves heating the wool in air to a standard temperature above 100° C. The Bradford Conditioning House uses a temperature of about 115° C. (235°-240° F.).

If wool be heated however in dry air (dried by passage over the usual drying agents) there is a further loss of from ½% to 2%.

In the present paper the samples were heated to 103° C and may therefore be assumed to have contained up to 2% of moisture.

I am unable to continue this work at present but the action of SO_2 upon chemically dry wool might repay study at other hands.

figures is probably due to differences in the methods of scouring the wool and to differences in the original samples themselves; it is quite conceivable that wools from different sources would show different absorption values.

In spite of the negative, quantitative results described above, qualitative experiments showed distinctly that the bleaching of wool with sulphurous acid involves the chemical combination of the acid with some component of the material. When moist wool, bleached with sulphur dioxide, is subsequently washed well with several portions of distilled water and then left in a vacuum over caustic potash during a period of about two weeks, it undergoes no visible change; but when it is then treated with dilute sulphuric acid it is partially debleached, and a distinct smell of sulphur dioxide can be detected. It may be concluded therefore that one factor in the bleaching of wool with sulphur dioxide is a combination of a coloured component of the material with the gas, or more probably with sulphurous acid; if the latter merely combined with some colourless amino-acid or other basic substance to form a sulphite, the decomposition of such a salt would not be accompanied by a debleaching effect. It seems probable therefore that the coloured substance which combines with the sulphurous acid is quinonoid in constitution, or at any rate a carbonyl compound (see later p. T383); the additive product, moreover, contrary to what seems to be assumed by some writers, is obviously only sparingly soluble in cold water.

Attempts were next made to find out whether, in addition to the fixation of sulphurous acid, there was any reduction of a coloured substance to a leuco compound; if such a change occurred, sulphuric acid must also be produced, $H_2SO_3+H_2O=H_2SO_4+2H$, and its presence, after bleaching, if established, would lend strong support to the view that a leuco-compound is formed.

Since sulphur dioxide is oxidised by atmospheric oxygen, and is appreciably decomposed by light, giving sulphur, sulphuric acid, and certain thionic acids, these experiments were very troublesome; but apparatus was devised in which wool, which had been previously extracted with alcohol and ether and then well washed with a dilute solution of sodium carbonate until free from sulphates, was treated with pure sulphur dioxide in glass vessels coated with black enamel. The occluded oxygen in the wool and the atmospheric oxygen in the apparatus were removed by filling the whole system with pure hydrogen and then exhausting, these operations being repeated six times before admitting the sulphur dioxide; the hydrogen was freed from oxygen by passing it through three wash bottles containing an alkaline solution of pyrogallol.

After displacing the hydrogen by pure sulphur dioxide and leaving the wool in contact with the gas for about twenty hours, the sulphur dioxide was removed as far as possible by prolonged evacuation; an air-free 4% solution of sodium carbonate was then admitted into the apparatus to extract from the wool any sulphuric acid which had been produced, and the extract was run into excess of dilute air-free hydrochloric acid; the acid solution was then evaporated almost to dryness under reduced pressure. All these operations were carried out in the closed glass apparatus in absence of oxygen and of light.

The concentrated acid solution was next diluted and filtered (in the air) in order to free it from traces of sulphur, produced by the interaction of sodium sulphite and sodium sulphide, the latter of which is formed by the action of sodium carbonate on the wool; the filtered solution was then

treated with barium chloride solution, and the weight of the precipitated barium sulphate determined.

Four very concordant experiments gave an average of 0·023 gram of sulphuric acid when the weight of the wool, containing 13 per cent. of water, was 50 grams; or 0·053 gram of sulphuric acid per 100 grams of "dry" wool. Further experiments showed, however, that it is very doubtful whether even the small quantity of sulphuric acid which was found in the experiments just described had any connection whatever with the bleaching of some coloured substance, because if this acid had been produced as the result of the formation of some leuco-compound, a repetition of the experiment with the same sample of wool, now bleached and left in the air-free apparatus, should give a much smaller quantity of the acid or none at all. A second treatment was therefore carried out exactly as before, except that no hydrogen was used, because there was no air in the apparatus; the quantity of sulphuric acid obtained in this second treatment was practically the same as in the first, and in fact the same wool, treated ten times with sulphur dioxide in the total absence of oxygen, gave each time approximately the same amount of sulphuric acid as in the first experiment. An obvious explanation of these results would be, of course, that oxygen gained admission during the experiment, owing to defective apparatus or that the sulphuric acid was contained in the reagents which were used; several blank experiments were therefore carried out, using a little concentrated solution of sodium carbonate in the place of the wool, all other conditions remaining unchanged; not a trace of sulphuric acid was produced in any case. No satisfactory explanation of this formation of sulphuric acid can be advanced, but the conclusion seems to be justifiable that the bleaching of wool with sulphur dioxide does not involve the addition of hydrogen to a coloured substance. This conclusion is confirmed by the fact that when unbleached wool is well padded with finely divided magnesium and then placed in dilute acid until all the magnesium has dissolved, no bleaching effect whatever is observed; wool left during 24 hours at ordinary temperatures in a solution of formalin appears to be bleached to a slight extent, but under all conditions which we tried the action of formalin is far less than that of sulphur dioxide.

The Presence of a Carbonyl Group in Wool

Up to this stage the experiments seemed to show that the bleaching effect of sulphur dioxide was caused by the addition of sulphurous acid to some coloured component of the wool. Since direct combination with sodium hydrogen sulphite is a property of the carbonyl grouping, it seemed probable that, as already suggested by Gebhard (*Jour. Soc. Chem. Ind.*, 1914), some ketonic compound in the wool is converted into a colourless additive product—

$$>C\begin{cases}OH\\O.SO.OH\end{cases}$$

This view would explain several facts observed by the author, namely, that the presence of small quantities of alkali improve the quality of the bleaching obtained with sulphur dioxide; that when bleached wool is treated with dilute alkalis or soap, it almost immediately reverts to its original colour, even in the complete absence of air; and when bleached wool is boiled with water, debleaching occurs with evolution of sulphur dioxide. On the other hand, it would be contrary to the author's observation that

bleaching with a concentrated solution of sodium hydrogen sulphite is less effective than with sulphurous acid, since the former, apparently, combines with ketonic compounds more readily than the latter.

In order, then, to obtain some evidence as to the presence of the carbonyl grouping, unbleached wool was heated under a reflux apparatus during four hours with an alcoholic solution of hydroxylamine. At the end of that time the wool was removed, pressed, and thoroughly washed with warm distilled water, dilute acetic acid, and again with water. The treated wool and a sample of the original material were then dried at 100° in the same oven, and the percentage of nitrogen determined in each by the Kjeldahl method. The results were as follows—

		Original Wool		Treated Wool		Average Difference
Nitrogen%	...	17·72	...	18·0	...	0·3
	...	17·61	...	17·95	...	

A second series of experiments with a different sample of wool, carried out exactly as before, gave the following results—Nitrogen%, average difference, 0·185.

The increased percentage of nitrogen in the treated material is no doubt very small, but seems to be too large to be due to experimental error. If it were assumed that the carbonyl compound in the wool has a molecular weight of 200 (a purely arbitrary number), the above increase in the percentage of nitrogen would correspond with that required for about 4% of such a compound.

That the increased nitrogen content of the wool is due to a reaction with hydroxylamine having taken place, and not merely to an adsorption, seems to be proved by the following facts—The treated wool gives with an aqueous or alcoholic solution of ferric chloride a deep violet colour, and it does so even when it has been soaked in warm dilute hydrochloric acid for a prolonged period and then washed with water; only after it has been heated with concentrated hydrochloric acid does it cease to give a coloration with ferric chloride, but at the same time the fibre is very much disintegrated.

As the presumed formation of an oxime indicated the presence of a carbonyl compound in wool, an experiment was next made to ascertain whether the carbonyl compound was or was not contributory to the colour of the raw material. For this purpose a sample of pure unbleached wool was treated with a neutral 2-volume solution of hydrogen peroxide during two days, and was then thoroughly washed; this bleached material was then treated exactly as before with an alcoholic solution of hydroxylamine, and subsequently washed well with a alcohol, water and dilute acetic acid. When treated with ferric chloride, this wool gave a violet coloration, which, so far as could be ascertained, was of exactly the same shade as that produced by the oximated wool, which had not been treated with hydrogen peroxide. It must be concluded, then, that the colouring matter in wool which is oxidised by hydrogen peroxide is not the carbonyl compound which reacts with hydroxylamine.

If the interaction of wool and hydroxylamine is the normal change which occurs in the case of a carbonyl compound $>CO+NH_2{\cdot}OH \longrightarrow C{=}N{\cdot}OH + H_2O$, the treatment of wool with semi-carbazide should give a semicarbazone $>C{=}NH{\cdot}NH{\cdot}CO{\cdot}NH_2$, and the increase in the percentage of nitrogen should be approximately three times as great as in the case of hydroxylamine. Two samples of unbleached wool were divided into two parts;

one part of each was steeped in a warm alcoholic solution of semi-carbazide during about 24 hours, and was then squeezed out and thoroughly washed with alcohol, warm water, dilute acetic acid, and water again, successively. The treated samples were then dried in the same oven as the untreated samples, and all four were analysed—

	Untreated Wool		Treated Wool		Difference
Sample A—Nitrogen %	18·20	...	19·1	...	0·9
	18·20	...			
Sample B—	18·12	...	18·87	...	0·8
	18·03	...			

These results afford a very satisfactory confirmation of those obtained with hydroxylamine, and seem to show conclusively that one or more of the components of wool is a carbonyl compound.

The author is greatly indebted to Prof. Kipping, F.R.S., of University College, Nottingham, for the constant interest which he has taken in this work.

36—THE SULPHUR CONTENT OF WOOL PART I.—INHERENT VARIATIONS ACCORDING TO THE TYPE OF WOOL

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SUMMARY

The sulphur content of a number of different wools has been determined. A review of the methods available for the determination of sulphur is given, and of these the Carius method is regarded as the most suitable for a substance of the nature of wool, and this method has been used throughout the present work. A modified method for the determination of moisture content, suitable for small samples, is described, and it is shown that regains determined by this method of thorough drying are somewhat higher than those obtained by use of the commercial conditioning oven. Incidentally, it is shown that if a kempy wool, e.g. a Blackface wool, be separated into two grades, say, fine non-kempy and coarse kempy, the regains of the two fractions are the same. It is shown that there is an inherent variation in the sulphur content, according to the type of wool. Generally speaking, finer qualities show a higher sulphur content than coarser qualities. There are also definite variations between different wools of the same quality and breed, and in pedigree flocks the sulphur content varies with different animals. Variations occur in different parts of the same fleece, particularly in coarser varieties, and in the same animal there are indications of variation of sulphur content in different shearings. Kempy wools show a lower sulphur content than non-kempy wools. The lowest value so far obtained is with a sample of coarse Turkey mohair. The sulphur content in relation to a number of factors is under investigation.

INTRODUCTION

The principal constituent of wool is keratin, which belongs to the class of proteins known as scleroproteins. Its composition and properties have been dealt with in a previous paper (Barritt, *J. Text. Inst.*, 1926, **17**, T111). Keratin undoubtedly varies somewhat in composition according to its source, and its sulphur content appears to be particularly sensitive in this respect.

Sulphur may be regarded as the most characteristic constituent of wool substance, and its presence distinguishes wool and hair from certain other proteins. It was therefore felt that a careful investigation of the sulphur content of different types of wool might afford valuable information both from the scientific and commercial standpoints. According to the literature the sulphur content of wool and similar materials (i.e., keratin substances) appears to vary between the limits of 0·7% and 5% (Bourquelot, *Pharm. Journ*, III. 19, 1035), but it must be remarked that many of the determinations of sulphur recorded have been indirect, being estimated from the yield of cystin obtained on hydrolysis of the keratin by acids. Such results are very questionable, since the method depends on all the sulphur being obtained as cystin, and in addition it is probable that much of the cystin obtained was far from pure, the preparation of pure cystin in quantitative amount from a keratin being a very difficult operation.

Previous work on the subject of the sulphur content of wool has been summarised by Trotman and Bell (*J.S.C.I.*, 1926, **45**, 12T). They were

unable to confirm the varying percentages of sulphur found by different workers, and concluded that the sulphur content of wool varies within quite narrow limits. Their published results given for three wools are—

	Max.		Min.		Mean	
Leicester wether	3·41	...	3·00	...	3·29%	Average 3·22%
Leicester hog ...	3·26	...	3·02	...	3·17%	
Black face ...	3·32	...	2·90	...	3·20%	

and they also give the percentage of sulphur in a low grade web as 3·24%. Their conclusion is as follows—"Consideration of the above results indicates that there is very little variation in the percentage of sulphur in purified wool, and that 3·4% is probably the maximum value."

It is not clear from the above table whether the maxima and minima, e.g., in the case of the Leicester wether, viz., 3·41% and 3·00% refer to sulphur determinations on the same fleece, or to determinations on different fleeces. In the event of the first supposition being correct, the results suggest that the method used, viz., the "Denis-Benedict" method, is not sufficiently accurate for the determinations of sulphur in a substance of the nature of wool, and if the second supposition be correct the variations are far from being insignificant.

Possible variations in the sulphur content of wools, assuming no inherent variability, may be caused to some extent by—

(1) The mode of preparing the samples.

(2) Neglect of variable regain under different conditions.

(3) Influences to which the fleece may have been subjected prior to shearing.

Under this heading are the possible effect of dips, especially sulphur dips, on the sulphur content, and the effect of weather.

Some sorption of sulphur may possibly occur with sulphur dips, but this is unlikely to cause actual addition of sulphur to any appreciable extent, since the fleece is very short when dipped.

Regarding the effect of weather, Bergen (*Textilberichte*, 1925, **6**, 745, *J.S.C.I.*, 1926, **45**, B 312) has pointed out that wool exposed to light becomes acid, due to conversion of some of the sulphur present into sulphuric acid. It is probable that the main portion of the fleece will be protected from this action, and that the total sulphur will only be very slightly affected.

It is intended to go further into this question, which, however, is outside the scope of the present paper, the values given in which refer only to the total sulphur content.

Also the normal sulphur content of wool cannot be safely ascertained from any processed wools, and *wools that have been scoured, crabbed, &c., will be separately examined.

While it is essential to remove dirt and wool fat, both of which are liable to contain sulphur, it is preferable to avoid soap or alkali in the scouring, and to use solvents free from sulphur. Further, wool has the power to absorb both sulphur dioxide and hydrogen sulphide, and undue contact with laboratory fumes must be avoided. Any variation in the moisture content will naturally give different values for the sulphur content. It is unfortunate that in much of the work published on the composition and properties of wool, the moisture content of the material used has not been

* In this connection it may be noted that blending of wools will tend to average out any variation, and that analyses of tops or cloth or web can be of little value in investigating inherent variations.

accurately specified. In the present paper it is shown that the sulphur content of wool is variable, and the variability is inherent, i.e., the sulphur content of one type of wool may, and in general does, differ from the sulphur content of another wool.

Methods of Determination of the Sulphur Contents of Wool

In any method involving the determination of sulphur in wool it is essential to know the moisture content of the wool at the time of weighing out the sample to be used. In the present work this was achieved by bottling samples for sulphur analysis, and at the same time bottling a sample for the determination of the moisture content of the wool (see below), the wool being previously stored in the humidity room, which was kept at a definite relative humidity. It was thought preferable to adopt this method rather than use a dried-out sample for the determination of the sulphur content for two reasons—

(1) Wool possesses the property of picking up moisture very rapidly, and is therefore difficult to work with in a dry condition; and

(2) To guard against the possibility that wool on drying out may lose volatile sulphur compounds, though this from experiments carried out appears to be improbable.

Almost all methods used for the determination of sulphur in organic compounds involve the oxidation of the sulphur to sulphuric acid and subsequent precipitation as barium sulphate. In the precipitation of barium sulphate from a solution containing free or combined sulphuric acid it is desirable to have no tervalent metals present, and it is found that when the amount even of a bivalent metal becomes relatively large in comparison with the amount of sulphuric acid present, the error arising from occlusion is likely to be large. On similar grounds the presence of nitric or chloric acids is undesirable.

In practice methods of determining sulphur may be divided into two groups—

(*a*) Dry or fusion methods.

(*b*) Wet methods.

An outline of these is given below.

Fusion Methods for the Determination of Sulphur

Liebig's Method.—A mixture of 8 parts of potassium hydroxide and 1 part of potassiumn nitrate is melted in a silver crucible with the addition of a little water. After cooling the substance is added and the contents of the crucible cautiously heated, and the mixture frequently stirred by means of a silver wire until the organic substance is completely decomposed. The melt is allowed to cool, extracted with water, acidified with hydrochloric acid, and the sulphuric acid precipitated and estimated as barium sulphate.

Warunis (*Chem. Ztg.*, 1910, **34**, 1285; *J. Amer. Chem. Soc.*, 1911, A, 1244) employs a method somewhat similar to the Liebig method. In a silver crucible 0·2 to 0·4 grams of the substance is mixed intimately with a mixture of 10 grams finely powdered potassium hydroxide and 5 grams sodium peroxide. The crucible is gently heated and the melt kept liquid for some time. The cooled melt is extracted with water, acidified with hydrochloric acid, a little bromine added, and the liquid boiled to expel bromine and the sulphuric acid estimated as barium sulphate.

Latshaw (*J. Assoc. Official Agr. Chem.*, 1921, **5**, 136-8; *J. Amer. Chem. Soc.*, 1922, A. **16**, 576, 3349; and *J. Amer. Chem. Soc.*, 1923, A. **17**, 2923)

has determined the sulphur content of seeds and feeding stuffs, and has made comparative tests on three methods—

(*a*) The Parr peroxide bomb method, in which the substance is burnt in a bomb with sodium peroxide.
(*b*) A method employing magnesium nitrate as an oxidising agent.
(*c*) The official method in which the substance is fused with a mixture of sodium carbonate and sodium peroxide, in a nickel crucible over a sulphur free flame.

All three methods gave satisfactory results, and Latshaw recommends the use of the magnesium nitrate method owing to its ease of manipulation and accuracy. Trotman and Bell (*supra*), working on wool, were unable to obtain satisfactory results employing the magnesium nitrate method.

Kaye and Sharp (*India Rubber J.*, **44**, p.1189; *J. Amer. Chem. Soc.*, 1913, A., p. 1106) use the following method for the determination of sulphur in rubber, and suggest the extension of the method to organic substances in general. A suitable amount of the finely divided sample is weighed into a porcelain crucible, and mixed intimately with eight times its weight of pure zinc oxide and four times its weight of potassium nitrate. The mixture is covered with a thin layer of zinc oxide and gently heated. When the mixture reacts the flame is removed till the action has subsided. The crucible lid is then removed, and the contents strongly heated for about five minutes. The whole is allowed to cool, the melt extracted with hot dilute hydrochloric acid, the crucible and lid removed from the heater, the contents of which are filtered and sulphuric acid estimated as barium sulphate.

Abderhalden and Funk (*Z. Physiol. Chem.*, **58**, 331; *J. Amer. Chem. Soc.*, 1909, A., 2009) have used the sodium peroxide method for the determination of sulphur in urine. The urine is evaporated down with sodium carbonate and lactose, and this residue mixed with sodium peroxide and fused.

Barlow (*J. Landw*, 1903, **51**, 289-313; and *J. Chem. Soc.*, 1904, **85**, A. ii., 82) uses a combustion method for estimation of sulphur in organic substances. The substance is heated in a combustion tube, first in a current of carbon dioxide and then in oxygen, the gases being passed over heated soda quartz (prepared by mixing sand with 3 to 4 grams sodium carbonate dissolved in water and drying) in the front part of the tube, the end of which is drawn out and turned down to dip into a beaker of water. At the end of the combustion the soda ash, asbestos, &c., are emptied into a dish into which the tube is rinsed with water and dilute hydrochloric acid. The liquor is evaporated to dryness, heated at 110° C., and the residue extracted with dilute hydrochloric acid. The sulphuric acid is precipitated as barium sulphate in the usual manner. The method is stated to give very exact results.

Feigl and Schorr (*Z. Anal. Chem.*, 1923, **23**, 10-29; *J. Chem. Soc.*, 1923, A ii., 784) heat the substance with twice its weight of a mixture of equal parts of sodium carbonate and potassium permanganate under a layer of the same mixture in an iron crucible for one hour at a low red heat. The mass is extracted with aqueous alcohol and the sulphur estimated as barium sulphate.

Schreiber (*J. Amer. Chem. Soc.*, 1910, **32**, 977-85) uses a method involving oxidation by magnesium nitrate. The material is mixed in a nickel crucible with a solution containing sodium nitrate and sodium hydroxide (use for

a 1 gram. sample 10 ccs. of a solution containing 100 grams of sodium nitrate and 150 grams sodium hydroxide per 500 ccs. of solution), 5 grams of crystallised magnesium nitrate are added, the mass well mixed and carefully evaporated to dryness, and eventually strongly heated. The mass is dissolved out with dilute hydrochloric acid, the solution filtered and precipitated with barium chloride. The method is said to agree to within 0·1% with the peroxide and the combustion method of Barlow (*supra*).

Hutin (*Ann. Chim. Analyt.*, 1915, **20**, 214; *J. Soc. Chem. Ind.*, 1915, p. 1105) uses a modified Schreiber method for the estimation of sulphur in rubber. The sample is decomposed by an excess of nitric acid, the liquid evaporated to a syrup, made alkaline with sodium hydroxide and mixed with calcined magnesia to form a stiff paste, which is carefully dried and ignited cautiously. After ignition the residue is dissolved in hydrochloric acid and the sulphur precipitated as barium sulphate.

Stevens (*Analyst*, 1918, **43**, 377) also uses a modified Schreiber method for the estimation of sulphur in rubber. The sample is digested with nitric acid and a little potassium chlorate. The mixture is refluxed for a few hours, evaporated to dryness, and mixed with pure magnesium nitrate. The mixture is carefully heated, and unburnt carbon is destroyed by digestion with nitric acid and potassium chlorate and excess nitric acid removed. The residue is treated with strong hydrochloric acid, evaporated to dryness, and sulphuric acid precipitated as barium sulphate.

The Denis-Benedict Method (Benedict, *J. Biol. Chem.*, 1909, VI., 363; and Denis, *J. Biol. Chem.*, 1910, VIII., 401).—The method was introduced by Benedict for the estimation of sulphur in urine, the urine being evaporated down with a suitable amount of a solution containing copper nitrate and sodium or potassium chlorate, and subsequently ignited. Denis modified the method by using a solution containing copper nitrate, sodium chloride and ammonium nitrate. The residue is dissolved in dilute hydrochloric acid, and the sulphate estimated as barium sulphate.

Trotman and Bell (*supra*), in estimating the sulphur in wool modify the method as follows—The wool is warmed with a little sodium hydroxide solution till it has just dissolved. A few drops of bromine are added, and after a few minutes the solution is neutralised with nitric acid, the Benedict-Denis reagent added, and the estimation continued as described above.

Halvesson (*J. Amer. Chem. Soc.*, 1919, **41**, 1494) has modified the Denis-Benedict method for the estimation of sulphur in fæces, foods, &c. The sample is heated in a Kjeldahl flask with water, and afterwards with nitric acid till the solution is clear. At this stage the residue is treated exactly as in the Denis-Benedict method.

Methods not Involving the Fusion or Ignition of the Substance

White (*Proc. S. Dak. Acad. Sci.*, 1919, **3**, 43; and *J. Amer. Chem. Soc.*, 1920, A **14**, 1760) estimates the sulphur in wool by digesting the wool with a mixture of sodium hydroxide and lead acetate. The mixture is acidified with acetic acid, and the precipitated lead sulphide is collected. The lead sulphide is decomposed and the lead finally estimated as chromate.

Osborne (*J. Amer. Chem. Soc.*, 1902, **21**, 140) has worked upon the method and has shown that in general the results obtained by the White method are too low, a result to be expected.

Gill and Grindley (*J. Amer. Chem. Soc.*, 1909, **31**, 52), for the determination of sulphur in urine, reject the sodium peroxide fusion method of Folin

(*J. Biol. Chem.*, **1**, 157), and employ a method involving oxidation with fuming nitric acid and potassium nitrate, the oxidation being carried out in a Kjeldahl flask. They arrive at the conclusion that in general fusion methods are incorrect, the fused residue often evolving hydrogen sulphide when acidified. Other workers have used as additions to nitric acid for oxidation, potassium chlorate, bromine perchloric acid, &c., and for details of these methods reference may be made to the paper of Trotman and Bell (*supra*).

The Carius Method.—This method is well known, and is in general use for the determination of many elements, other than carbon, hydrogen, and nitrogen, present in organic compounds. The method is simple, and consists in heating the substance under pressure in sealed tubes with nitric acid, when oxidation ensues. It has been subjected to many modifications, almost all of which have been designed to eliminate the use of sealed tubes.

Advantages of the Carius Method

The method avoids the addition of many salts used in other methods, and therefore avoids the risk of the contamination of the barium sulphate precipitate. It is easily controlled, and after the sealing of the tubes and the initial gradual heating to the desired temperature it requires no attention. At no stage of the process is there a risk of contamination of sulphur from gas burners, as exists in all processes where metal crucibles have to be heated for lengthy periods. The only disadvantage of the Carius process (apart from the labour involved in making sealed tubes) is the fact that the glass is liable to be attacked with formation of silicates with subsequent contamination of the barium sulphate precipitate by silica.

Rupp (*Chem. Ztg.*, **32**, 984; *J. Amer. Chem. Soc.*, 1909, A, p. 296) advocates the addition of barium nitrate to the Carius tube. The barium sulphate formed contaminated with more or less barium nitrate* is washed out off the tube into a beaker, boiled up with water, and collected on a filter.

Anelli (*Gazzetta*, 1911, **41**, I. 334; *J. Amer. Chem. Soc.*, 1911, A. 1379) showed that in the ordinary Carius estimation silica is found with the barium sulphate, this leading to high results. The use of barium nitrate in the Carius tube is advocated.

In the determinations given below, no addition of barium nitrate was made to the Carius tube, but the amount of silica in the barium sulphate was estimated and found to be only ·08%, and therefore the sulphur content of wools in the work described is influenced to less than 1 part in 1,200 by this factor.

PREPARATION OF THE WOOL

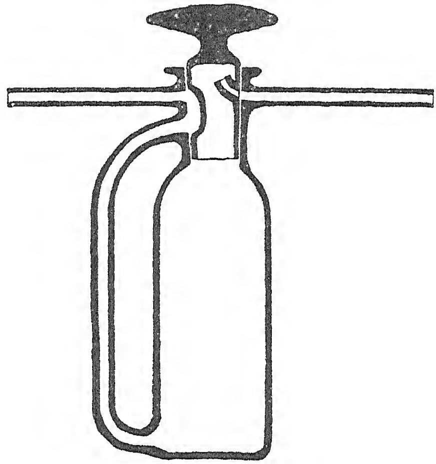
The wool was treated with sulphur-free benzene, worked about for some time, and the hard fatty portions which are sometimes present opened out as much as possible. It was withdrawn from the benzene, well squeezed out, and allowed to dry in warm air. The wool was now hand-sorted to remove the greater portion of foreign matter, a somewhat tedious process but essential to ensure complete removal of all vegetable and other foreign matter from the wool. The sorted wool was now extracted two or three times with pure benzene to remove all remaining grease, and then allowed to dry as before. At this stage it was again hand-sorted, and finally was given a scour in very dilute saponin solution, well washed off in distilled water, and left to dry in warm air. The samples were transferred to the humidity room and

* Evaporation to dryness with hydrochloric acid, to remove nitric acid, appears desirable at this stage.

kept in wire cages for a few days to condition equally. The above method of purification was adopted so as to ensure as little change as possible in the natural condition of the wool.

Method Used for Determination of Moisture Content

In estimating the sulphur content of wool it is essential to know the moisture content of the wool at the time it is taken for the sulphur determination. All sulphur determinations were carried out in duplicate, and a moisture content determination made at the same time. Two samples of wool (about 0·5 grams of wool per sample) were weighed out in small weighing



bottles for the determination of the sulphur, and at the same time a third weighed sample was taken in the special bottle described below.

The special bottle* (see diagram) used for this determination was designed so that with one position of the tap a current of air could be drawn through the wool, entering at the bottom of the bottle, and on turning the tap through 90° the bottle was completely closed. The use of a bottle of this type capable of giving accurate values for moisture content with quantities of wool down to 1 gram was necessary owing to the fact that many of the samples were small—too small, in fact, for use in an ordinary conditioning oven, which requires at least 20 grams of wool.

The bottle containing the weighed wool sample was placed in an electrically heated oven kept at 104° to 106° C., and a current of dry air, dried by means of the usual drying agents (sulphuric acid and calcium chloride) was passed through. After 1½ to 2 hours the tap was closed and the bottle transferred to a desiccator for half an hour and then weighed. The bottle was reheated for half an hour and its weight taken. This was repeated until the weight was constant, and in almost all cases two reheatings were sufficient, and in many cases only one reheating was found to be necessary.

Discrepancy in Dry Weight from Above Method and Conditioning Oven

In checking this method for the determination of moisture content against the method used in commercial practice, i.e., drying out wool in a conditioning oven at about 235° F., it was shown quite conclusively that the percentage regain as determined by the bottle method came out higher

* This bottle was supplied by Messrs. Standley, Belcher & Mason.

than that found with the conditioning oven, the difference being about 1%, for example, 15% in place of 14%. Passing undried air through the bottle gave a regain intermediate between the values obtained with the conditioning oven, and the dry air bottle method.

A fuller investigation will be made in the Physics Department of the Association.

In this paper the regains refer to the dry weight obtained in a current of dry air at 104°-106° C., and not to that from the ordinary conditioning oven.

REGAIN OF KEMP

It is interesting to note the equal regain shown by kempy and non-kempy portions of the same fleece, both with Blackface wool and Turkey mohair. The black face was separated by hand sorting into three fractions, which may be called

(*a*) Fine non-kempy fibres.
(*b*) Coarse kempy fibres.
(*c*) Kemps.†

All three fractions were placed in the humidity room, and samples from (*a*) and (*b*) were bottled simultaneously both for sulphur and for regain determinations. The regain of (*a*) and (*b*) were almost identical, being—

Fine non-kempy fibres ...	15·66%
Coarse kempy fibres ...	15·62%

and on the evidence of these determinations the kempy fraction was assumed to have a regain of 15·62%.

In the case of mohair the regains are as follows—

Fine mohair	15·64%
Coarse mohair	15·68%

Details of the Sulphur Determination

About 3 ccs. of fuming nitric acid (s.g.=1·53) were transferred by means of a long funnel and pipette to the bottom of a Carius tube, and wool transferred by means of forceps and pushed down the tube to within about 6 inches of the bottom by means of a glass rod. The tube was sealed in the usual manner, and estimations were carried out in duplicate for each wool. The tubes were heated together in the Carius furnace, and in a period of about 1½ hours the tubes were raised to 200° C. and maintained at this temperature for eight hours. Each tube was allowed to cool overnight and opened by softening the tip with a Bunsen flame, a slight pressure being found in the tube. After withdrawing from the furnace and cutting off the ends, the tubes were gently warmed to drive off dissolved gases, and the contents were washed out into beakers, evaporated to dryness (on steam) with the addition of hydrochloric acid, this being repeated to remove all traces of nitric acid, which is detrimental to the sulphate estimation. About 100 ccs. of hot distilled water were added, and the contents filtered off to remove any traces of glass introduced when opening the tubes. The liquid, about 400 ccs. in volume, was acidified with dilute hydrochloric acid, heated to boiling and precipitated by the slow addition of 50 ccs. of boiling N/20 barium chloride. After keeping hot for some hours and allowing to stand overnight, the barium sulphate was collected and estimated on a weighed Gooch crucible in the usual way.

† The reason a regain determination was not carried out on "(*c*)" was that only about 0·5 gram of the sample was available, a very large amount of Blackface having to be sorted to obtain this amount.

It should be especially noted that to ensure complete breaking up of the wool it is essential that the temperature of the tubes be not less than 200° C., and further that only a short length, at the most one inch of the tube, project beyond the iron containing tube. In one or two cases when these conditions were not observed, on opening the tubes a smell of oxy-butyric acid was observed, and when washed out the contents of the tube formed a yellow solution, and usually a low result for sulphur content was obtained. Results from any wool showing a difference in sulphur content in two determinations of above 1 part in 100 were rejected and the analyses repeated.

The sulphur content of between 40 and 50 wools has been determined, the following table showing some of the typical results. The lowest value found for sulphur content is that for coarse mohair, the value being 3·03%. The highest value found is that of 4·13% for a wool from a Welsh mountain sheep, this being one of a series of nine wools examined.

It is proposed in a subsequent paper to deal with the qualities of wools, in relation to their sulphur content, but it may at once be remarked that the lowest values of sulphur content are found with coarse wools (*cf.* following table).

Table of Typical Results

Type of Wool.	%'s of Sulphur found I.	II.	Regain	%'s of Sulphur on Dry Weight	Remarks
Australian merino, 100's	3·25	3·21	16·44	3·76	
Lamb's wool merino ...	3·20	3·19	16·76	3·73	
Lincoln (white)	2·67	2·68	15·89	3·10	Two samples from different fleeces, one fleece very yellow, other fairly white.
Lincoln (yellow)... ...	2·77	2·79	15·95	3·26	
Turkey mohair (fine) ...	2·89	2·92	15·64	3·36	The mohair was separated by hand sorting into two fractions.
Turkey mohair (coarse)	2·62	2·63	15·68	3·03	
Fine Ripon fleece ...	2·85	2·87	16·74	3·34	
Peruvian (1924) ...	3·23	3·21	16·47	3·75	Samples from the same sheep, clipped one year apart.
Peruvian (1925) ...	3·30	3·27	16·19	3·82	
Monte Video (Romney)	3·22	3·19	17·44	3·76	
Blackface Fine ...	3·29	3·31	15·66	3·82	Blackface was hand sorted into three fractions. The regain of the kempy fraction was taken as 15·62, i.e., equal to the regain of the coarse fraction.
Blackface Coarse ...	2·88	2·88	15·62	3·33	
Blackface Kempy ...	2·80	—	(15·62)	3·24	
Welsh mountain P. 64 ...	3·35	3·34	18·65	3·97	Two typical analyses from a series of analyses made on Welsh mountain sheep; the S's are the first clip and the P's the second clip.
Welsh mountain S. 71 ...	3·20	3·21	18·28	3·79	
Cape merino (Kaffrarian)	3·45	3·41	16·47	4·00	
Cape merino (Le Grange).	3·37	3·40	16·32	3·94	

A striking example of how sulphur content varies in different parts of the same fleece is to be found in the case of the black face wool. The wool

was separated by hand sorting into three fractions and the sulphur content of each fraction determined.

	% of Sulphur
Fine non-kempy wool	3·82
Coarse kempy fibres	3·33
Kemps	3·24

A similar result was obtained with Turkey mohair, the sulphur contents of fine and coarse fractions from the same sample being 3·36 and 3·03 respectively. The extreme values found in the 20 Australian pedigree wools examined were 3·46% and 4·11%, the mean value being 3·78%. The Welsh wools examined show variations between 3·75% and 4·13% in sulphur content, the mean value being 3·94%. It is of interest to note that the average sulphur content of the Welsh wools from the first shearing is 3·83%, whereas from the second shearing the value is 4·03%. Too much stress cannot be laid upon these figures owing to the comparatively small number of samples worked upon, but it is intended to follow up this question by examining samples of wool from the same sheep over a period of years; in addition the sulphur content in relation to a number of other factors is being investigated.

37—THE MICROSCOPICAL EXAMINATION OF DAMAGED COTTON HAIRS BY THE CONGO RED TEST AND THE SWELLING TEST OF FLEMING AND THAYSEN

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INTRODUCTION

During the course of investigations of the fine structure of the cotton hair, Miss G. G. Clegg, working in this laboratory, observed that hairs which had been swollen in sodium hydroxide and then stained in Congo Red did not become uniformly coloured, but took up the stain more intensely at points where the cuticle had become loosened or totally detached, and that this staining afforded a ready means of detecting damage to the cuticle. A method based upon these observations has now been worked out, and the present paper describes its application in determining microscopically the visible signs of damage in a Sakel cotton resulting from treatment in various ways, e.g., by heat, by mechanical means, by the action of a fungus, or by the action of acid. The method is shown to be capable of detecting even the slightest mechanical damage, and reveals in characteristic form the effect of heat or the attack of a fungus, though it is doubtful whether in all cases the last two effects could be distinguished one from the other. The changes brought about in cotton hairs by treatment in the cold with sulphuric acid of varying concentration are shown to be of a different nature from the other forms of damage investigated.

For the present work one cotton, a good quality Sakel, was used throughout, being examined in the undamaged state and after infliction of damage in varying degree under controlled conditions in the laboratory.

The only method which has so far been developed to reveal modifications of hair structure due to attack by micro-organisms and the probable resulting amount of deterioration ("tendering") is the swelling test of Fleming and Thaysen[6]. The conclusions of these workers have met with some adverse criticism, chiefly from Denham[3] and Burns[1], so the opportunity was taken to apply both the Congo Red test and the swelling test to similarly treated samples of the same cotton, and to compare the results. As an outcome, no general statement can be made about the performances of the two tests; their relative efficiencies vary according to the material on which they are used, and each case must be considered separately, bearing in mind the type and degree of damage that is being investigated.

THE METHOD OF APPLYING THE CONGO RED TEST AND THE RESULTS TO BE OBTAINED THEREFROM

About 0·1 gram of the cotton was placed in a filter flask of water, and as much air as possible withdrawn by means of the filter pump. This ensured that the cotton was thoroughly wetted out. It was then gently squeezed to remove most of the water, placed in 25 ccs. of an 11%* solution

* The use of solutions of exactly the right concentration is a matter of some importance. All solutions were made up more concentrated than actually required, and were then adjusted to the correct specific gravity, as obtained from the tables in the *Chemists' Year Book*. The percentages refer to grams per 100 grams of solution.

of sodium hydroxide, shaken thoroughly, and allowed to stand for five minutes. After washing rapidly in water, it was placed in a saturated (=about 2%) solution of Congo Red, and shaken at intervals for six minutes, when it was removed and washed by shaking up in water, the latter being changed until it no longer became pink. With as little delay as possible the cotton was placed in 18% sodium hydroxide, teased out, and a few hairs mounted in the same liquid for examination under the microscope. To prevent any of the sodium hydroxide escaping, the coverglass was sealed down with the cement recommended by Langeron[5]. The examination was made with $\frac{2}{3}$ in. objective and a $\times$10 eyepiece, the iris diaphragm of the substage condenser being left wide open so as to fill the back lens of the objective with light.

A normal undamaged cotton hair, on being placed in 11% sodium hydroxide, swells nearly to its full extent, as described by Calvert and Summers[2], and its irregular cross section changes to an ellipse. The cuticle, however, remains intact and, later, takes up the Congo Red to a slight extent only, becoming coloured a faint pink. Finally the 18% sodium hydroxide swells the cellulose of the hair still further, and in places actually bursts the cuticle, thus exposing to view a strip of white cellulose. The colour contrast between the pink and the white is by no means great, but can be seen in several hairs in Fig. 1. Where cotton has been damaged by mechanical means, the cuticle is cut or at least weakened at the point of damage. On application of the Congo Red test, the cellulose is exposed or may even protrude, and becomes deeply stained, giving the appearance of a bruise upon the hair. If the cotton has been damaged by exposure to heat, sulphuric acid, or the attack of a fungus, the appearance is different, and in each case more or less characteristic, as described in detail below.

An outstanding difficulty in the detailed examination of any cotton was encountered, namely, the large variation amongst the individual hairs. For the purpose in hand it was only necessary to consider one character, this being the amount of secondary cellulose laid down in the hair wall, for the variation in this was one of the only causes so far investigated of the difference in behaviour of cotton hairs in a swelling solution.[2] In most commercial cottons there were a certain number of fuzz hairs, which though short in length were extremely thick-walled. The lint hairs themselves varied considerably in this respect, ranging from hairs of large cellulose development down to thin-walled hairs almost devoid of thickening. If the cotton under examination by the Congo Red test contained any hairs with abnormal cellulose development, particularly fuzz hairs, the swelling in the weaker (11%) sodium hydroxide was generally sufficient to rupture the cuticle. In this case the cellulose bulged out, and during the treatment with Congo Red became deeply stained. Since the cuticle usually split in a line running spirally round the hair, the red band which appeared after the application of the Congo Red test followed this course (Fig. 2), and an examination with a high power objective showed the torn edge of the cuticle flanking this band. These spiral bands had previously been observed in hairs under somewhat similar treatment by other workers, notably Denham,[4] but their real character had not been described. Their occurrence did not necessarily indicate damage, but simply the presence of hairs with an extreme development of cellulose. When using the test to examine a cotton containing hairs of this type, it was found advisable to reduce the concentration of the sodium hydroxide in the preliminary swelling from 11% to 9%.

This gave a preparation consisting of hairs all stained faintly pink and free from spiral bands. On the other hand, if the cotton contained any hairs with less than the normal development of cellulose, these hairs took up the Congo Red evenly, but to a greater extent than normal ones. In extreme cases where the hair was immature in development and the wall very thin, deep red staining took place throughout, and the ribbon shape with convolutions was retained. Since nearly all cottons were found to contain a certain number of abnormal hairs, the appearance which these displayed after being treated by the Congo Red test had to be noted in order to avoid interpreting them as signs of damage.

The technique is simple to carry out if the cotton to be examined is at the most slightly damaged, for the hairs become entangled during the first swelling and can be transferred from one solution to another by means of a glass rod. But in a badly damaged sample the hairs are easily broken into small pieces, which become dispersed when the solutions are shaken, and are usually left behind during transfer from one liquid to another. However, in these circumstances loss can be avoided by filtering through glass-wool.

Material

In order to avoid the complications raised by the presence of so many types of hair, search was made for a cotton as free as possible from very thick- or thin-walled hairs. The cottons available for use were examined by the Congo Red test, and the one which appeared most satisfactory in this respect was a Sakel, grown in 1923 on the Egyptian State Domains Seed Farm, and forwarded to this laboratory as a representative sample. The total quantity available was about one pound, from which an experimental sample was collected by taking small bunches and drawing from each of these in turn a few groups of twenty or thirty hairs. To divide up these groups the whole of the experimental sample was then thoroughly mixed and test samples finally obtained by drawing small groups of hairs from different parts of the whole. Except in one or two cases where it is specially stated, this material was used throughout, and appears in all the illustrations.

Description of Results Obtained

"*Damage-free Cotton.*"—This description was reserved for cotton which after treatment by the test showed no sign of damage. A cotton which fulfilled this condition was obtained from some specially chosen bolls of Punjab-American-285F. All the hairs were stained pink, and deep red staining was completely absent except at the end of each hair where this had been torn from the seed, and where naturally mechanical damage had taken place, giving the Congo Red immediate access to the cellulose. Any ruptures of the cuticle due to the final swelling in 18% sodium hydroxide showed as faint white stripes on the pink of the outside. Damage done during teasing out on the microscope slide was easily recognised by the absence of any red staining of the exposed cellulose (Fig. 5).

"*Commercial Undamaged.*"—Under this heading were included cottons that had been ginned and baled, as in ordinary commercial practice. In the case of the Sakel, most of the hairs were pink (Fig. 1), but a few showed bruises, and hairs which tapered at the end usually appeared as shown in Fig. 3. An occasional thick-walled hair showed broad spiral bands as in Fig. 2.

Mechanically Damaged Cotton.—This term was applied to two samples of the Sakel which had been subjected to mechanical damage in a mortar. Fig. 4 shows small bruises upon a hair that had been slightly damaged by being tapped gently with the pestle, and in Fig. 6 can be seen more extensive bruises. Fig. 7 shows the result of grinding up with great force; the bruises were so large and numerous as to cover almost the entire surface of the hairs, so that these appeared deeply stained and very ragged after the application of the test.

Heat Damaged Cotton.—This had been exposed to a temperature of 110° C. in an electrically heated thermostatic oven. It was found that the manner of exposure influenced the final result. If the sample was left between sheets of filter paper in a closed Petri dish for as long as six days the only sign of damage was the appearance of simple spiral bands in occasional hairs (Fig. 18). If, however, the cotton was freely suspended in a loop of asbestos string, 24 hours exposure was sufficient to produce spiral bands, either simple or multiple, in about 20% of the hairs. The regularity of the bands and the number of hairs possessing them increased with the time of exposure, until after a fortnight in the oven all the hairs were covered with multiple spirals. To obtain higher temperatures a small gas-heated oven was used, the cotton being again suspended in a loop of asbestos string. After four hours at about 150° C. it had become yellowish, and the Congo Red test showed that some of the hairs were covered with fine multiple-spiral bands, which displayed very clearly the points of reversal of the spiral (Fig. 19). Others, which were also spirally marked though less distinctly, were not swollen to the rod shape, but remained as ribbons with a corrugated outline (Fig. 20). Pronounced singeing was caused by exposure to a temperature of 190° C. for a similar period, and in such cases the hairs became stained red throughout, but again could not be swollen to the rod shape, remaining as ribbons with a corrugated outline and deep cracks. In some cases the cuticle could be seen as a wrinkled yellow ribbon wound spirally round the hair (Fig. 21). To test the effect of steam heat, the cotton was pushed about half way down a test tube, which was then plugged with bacteriological cotton wool, and the whole exposed to 15 lbs. per sq. in. steam pressure in an autoclave for 15 minutes. No sign of damage could be detected by means of the test, the hairs being free from any red staining.

Cotton Damaged by the Attack of a Fungus.—This cotton had been sterilised, inoculated with the spores of a fungus, and incubated at 25° C., some sterilised distilled water being added. The first fungus employed was a strain of *Aspergillus niger*, one of the commonest infections of raw cotton. The test showed evidence of damage to all the hairs, which in some places were stained evenly red (Fig. 16) and in others were covered with multiple spiral bands, similar to those produced by a temperature of 150° C. Cracks and abrasions, however, were totally absent. The second fungus, which still awaits identification, was employed on account of its great capacity for attacking the cotton hair and penetrating the central canal, or lumen. In this case the hairs were stained red throughout, broken up into short lengths, and covered with cracks and abrasions (Fig. 17).

Cotton Damaged by Sulphuric Acid.—The breaking loads of single hairs of Egyptian cotton after treatment with different concentrations of sulphuric acid in the cold had been determined by Vincent[9], so in order to find out to what extent the Congo Red test could indicate a decrease in strength due

to the action of sulphuric acid, this author's method of treatment was followed. The cotton was first wetted out under the filter pump, and then placed in about 200 ccs. of the acid solution; the whole was thoroughly shaken and allowed to stand for 48 hours. The cotton was then washed thoroughly in water and dried slowly in air. It was found that concentrations of acid up to 30% (=grams per 100 ccs. of solution) produced no effect that could be readily detected by the Congo Red test, but hairs that had been treated with 40% acid were covered with irregular red streaks and patches, quite different in appearance from the regular spiral bands produced by heat, or the swollen bruises found in cases of damage by mechanical means. In addition, the hairs were not fully swollen to the rod shape, but remained corrugated. These effects became more marked as the concentration of the acid was still further increased (Fig. 8).

THE SWELLING TEST OF FLEMING AND THAYSEN

The original microscopical test for damage to the cotton hair, developed by Fleming and Thaysen[6], the pioneer workers in this field, was based upon experiments by Balls with the viscose process of Cross and Bevan. Their method was employed to estimate only the damage caused by microorganisms, this term being used to denote bacteria and the streptothrices, which are intermediate between the true bacteria and the fungi, resembling sometimes one, sometimes the other, according to conditions. The cotton to be tested was swollen in a mixture of carbon disulphide and 15% sodium hydroxide, and examined under a low magnification, the damaged hairs being counted against the undamaged ones, and the count expressed as a percentage. In the present investigation some difficulty was experienced in carrying out the counts, but through the courtesy of Dr. Thaysen a visit was paid to the laboratory at Holton Heath and the points of misunderstanding were cleared up. For example, it must be noted that for the purpose of the count that portion of a hair in the field of the microscope at any one time was reckoned as one unit, so that a single complete hair figured in the count as several units, some of which might be classified as damaged and others as undamaged. It would appear that Burns[1] also misunderstood this method of making the count, and was thus led to criticise the test.

In the course of the work now described it was found that on placing a cotton hair in a mixture of 15% sodium hydroxide and carbon disulphide, the cellulose immediately expanded, inwardly to fill up the central canal, and outwardly to stretch the cuticle to its elastic limit. The reaction was complete in two or three minutes, and no further change occurred until, after about half an hour, the stress imposed by the expanding cellulose became sufficient to burst the cuticle. The line of rupture was a spiral one round the hair, so that the cuticle became rolled back upon itself to form a tightly stretched cord, which moulded the cellulose into a shape resembling either a chain of beads (Fig. 11) or a corkscrew (Fig. 13). The stages illustrated were only reached after swelling for about an hour, though the time required varied according to the type of hair and the amount of shaking applied. Further extension of the time of swelling caused the cellulose to dissolve at the edges, so that the general outline of the hair grew faint and ragged. If the test was applied to a hair with a cuticle that had been split or loosened, the cellulose, being no longer restricted at this point, expanded very rapidly and soon began to dissolve. The appearance presented by such a hair depended naturally on the length of time that it had been in

the swelling mixture; if the time was short, say less than half an hour, the undamaged portions of the hair were still free from beads, whilst an irregular bead was formed at the point of injury to the cuticle. A longer period of swelling resulted in the cellulose at this point going into solution and producing a break in the hair. Thus, slight mechanical damage, such as the Congo Red test had shown to be present in commercial cottons, was not easily recognisable as such under the conditions of the swelling test, but nevertheless its effect was present. Severe mechanical damage, on the other hand, as produced by grinding in a mortar, not only tore the cuticle but also lacerated the cellulose, leaving cracks which were plainly visible after swelling for, say, 20 minutes (Fig. 10). Longer exposure to the swelling mixture proved to be inadvisable, for many of the hairs began to dissolve, so that little could be learnt as to their condition; this was found to hold good for damage due to any of the causes investigated; indeed, an unduly prolonged period of swelling gave misleading results, the more badly damaged hairs dissolving and leaving only the less damaged ones to come up for examination.

The samples of the Sakel cotton referred to above (page 144) that had been attacked by fungi in pure culture, were also submitted to the swelling test. The hairs that had been exposed to the action of *Aspergillus niger* swelled evenly and without forming beads, but displayed spiral striations (Fig. 15) obviously corresponding to the multiple spiral bands produced in the same cotton by the Congo Red test. It seemed doubtful whether, in the absence of beading, these hairs should be classed as damaged, or, in the absence of any obvious surface injury, as undamaged. Dr. Thaysen expressed the opinion that no hair-portion should be counted as damaged unless it displayed definite cracks or abrasions. This sample therefore passed the swelling test as undamaged. In the second sample, that had been exposed to the lumen-invading fungus, surface damage was widespread (Fig. 14), very few hair-portions being fit to be counted as good. It was noted, however, that the injuries of some of the hairs resembled those produced by grinding almost to the point of being indistinguishable (Figs. 10 and 12), so that it would seem advisable to use the swelling test only on cottons known to be free from mechanical damage unless very slight.

The samples of the Sakel cotton that had been treated with sulphuric acid behaved in much the same way as those that had been exposed to heat, in that they formed no beads but expanded evenly, displaying numerous fine cracks; since these were very regular, and all at right angles to the axis of the hair (Fig. 9), they were easily recognisable and not likely to be confused with the injuries caused by micro-organisms.

There has in the past been some controversy as to the mode of attack of micro-organisms upon the cotton hair and its effect upon the test. Thaysen and Bunker[7,8], working upon raw cotton exposed to the attack of bacteria and streptothrices, stated that in their experience the attack always commenced at the outside of the hair wall and proceeded inwards, and that cases of lumen attack were exceedingly rare. Denham[3], on the other hand, found that, in material from a variety of sources, central canal invasion was very common, especially by fungi, and this was confirmed by Burns[1]. During the examination of a large number of samples of yarn and grey cloth for mildew damage, the writer saw many cases of isolated hairs which, though spun into the yarn, were penetrated from end to end of their central canals by hyphæ, without any trace of fungus appearing

on the outside of the hair or elsewhere in the yarn. It was concluded that these hairs had become infected either in the cotton field or in the bale, and had been separated from other hairs simultaneously attacked and also from fungus adhering to the outside by the redistribution which occurs in cotton spinning; for where raw cotton, yarn, or cloth had been exposed to the action of micro-organisms either under trade conditions or as a pure culture in the laboratory, the writer found that an invasion of the lumen was invariably accompanied by an attack upon the hair wall from outside, though the application of swelling or staining reagents in preparing a specimen for examination was often enough to remove the organism adhering to the outside, and so lead to the faulty conclusion that an internal attack alone had taken place. From the work carried out with pure cultures in this laboratory, it was clear that the habit of invading the lumen in the early stages of attack was a characteristic of certain fungi only, a notable case being the species mentioned above; and it was doubtful whether even this fungus could penetrate directly the wall of an undamaged hair. It was probable that the attack, whether external only or simultaneously internal and external, was not localised but distributed, so that the wall underwent a general degradation, in the later stages of which penetration occurred. Up to the present no test has been available which could detect the earlier stages of damage and so throw light on the mode of attack at its commencement, but in this connection it is hoped that the Congo Red test will be of assistance in future research.

THE SCOPE OF THE CONGO RED TEST

Burns[1] rightly pointed out that the percentage of damage as determined by the swelling test was no measure of the decrease in spinning value of a cotton, for the latter depends on the amount of waste due to fly and the strength of the yarn produced. Actually, the figure obtained by use of the swelling test was the percentage of hair-portions that had reached a certain stage of damage. As this stage appeared to be an advanced one, it was probable that these hair-portions would be eliminated during spinning as "card fly," leaving the remaining hairs or parts of hairs to form the yarn. About these the swelling test furnished no information, though in practice all might be undamaged, and so give good yarn, or all might be damaged and so give weak yarn. Here the Congo Red test could yield useful information, and its quantitative application might be brought about by counting first the number of units displaying signs of slight damage, namely spiral bands, secondly the number stained evenly red but without cracks, and lastly the number with cracks, i.e., those which would be condemned under the conditions of the swelling test. However, the values obtained from such a determination could only be rendered useful by their correlation with the results of spinning tests as indicated by Burns[1]. Further, as this author pointed out, in any such form of test, the number of hairs which could conveniently be examined under the microscope was comparatively small, and could only be considered to represent a sample of strictly limited dimensions. Burns himself, by increasing the number of hairs examined, rendered his test samples large enough to be representative of quantities suitable for spinning tests.

It should be emphasised that the swelling test and Congo Red test have not yet been studied with respect to their relation to the spinning values of cotton before and after damage. But in research work where it is desired

to study, say, the relative attacking power of an organism, some method of estimating the attack is necessary. For this purpose the swelling test appeared to be satisfactory, and the Congo Red test, being more sensitive to slight damage, might profitably be developed quantitatively along similar lines. For example, in the cases of damage by heat, fungus, or mechanical means, different stages of damage could be recognised from the appearance of the hairs as indicated in Table I. By applying Fleming and Thaysen's method of examining hairs by units, the percentage of units in any stage could be found and used as an index of damage, but far more meaning would be attached to such determinations if they could be correlated with the breaking loads of single hairs and the spinning value of the cotton.

Table I.

Appearances produced by the Congo Red Test in Cotton Hairs in different stages of degradation.

Degree of Damage	Appearance of hairs: Attacked by a Fungus	Exposed to Heat	Damaged by Mechanical Means	Treated with Sulphuric Acid
No damage	Stained pink ...	Stained pink ...	Stained pink ...	Stained pink
Slight damage	Narrow multiple red spiral bands ...	Broad simple red spiral bands ...	Surface bruises ...	—
Moderate damage	Stained evenly red...	Narrow multiple red spiral bands ...	Deep cuts ...	Irregular red patches
Severe damage	Stained red and cracked ...	Stained red and cuticle singed ...	—	—

As shown by the descriptions and illustrations of the damage caused by different means, it was seen that the test had the power of distinguishing one form of damage from another, but it was obvious that this would not hold good under all circumstances. Mechanical damage was unmistakable, and could not be confused with that due to heat or the action of a fungus; the last two, however, possessed points of similarity, but where a fungus was the cause, there always remained some trace of the organism itself, and there was no sign of the broad spiral bands or the singed cuticle which were found respectively in the first and last stages of heat damage. In this way they could be differentiated if the material were examined undisturbed, but if the damaged hairs had been mixed with undamaged ones, as would occur in sampling, and a preparation finally produced showing only a few of the former, it might not always be possible to make a decision. Further work remains to be done on cotton treated with sulphuric acid; at present it can only be said that the effect of treatment in the cold followed by washing can be recognised if the damage is severe; the result of treatment with warm acid, or of allowing the acid to dry on the cotton, has not yet been investigated by the Congo Red test.

The writer wishes to acknowledge the kindness of Dr. A. C. Thaysen, of the Bacteriological Laboratory, Royal Naval Cordite Factory, the author of the swelling test. In a series of consultations on both the swelling test and the Congo Red test, Dr. Thaysen and Mr. H. J. Bunker have contributed materially towards an accurate valuation of the performance of both tests,

and have suggested several modifications of technique which have been included in the description given above of the working of the Congo Red test.

The photographs are the work of Mr. H. Gunnery, who has given valued assistance throughout the research.

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EXPLANATION OF PLATES

The hairs were photographed with a Zeiss 16 mm. apochromatic objective and a Zeiss 15×compensating ocular (K 12), the magnification being 330 diameters; those shown in Figs. 9 to 15 had been treated by the swelling test, and the remainder by the Congo Red test.

Fig. 1—Congo Red test; normal hair, undamaged.
Fig. 2—Congo Red test; thick-walled hair, undamaged.
Fig. 3—Congo Red test; tapering end, undamaged.
Fig. 4—Congo Red test; slight mechanical damage.
Fig. 5—Congo Red test; damaged during teasing out.
Fig. 6—Congo Red test; mechanical damage.
Fig. 7—Congo Red test; severe mechanical damage.
Fig. 8—Congo Red test; damaged by sulphuric acid.
Fig. 9—Swelling test; damaged by heat.
Fig. 10—Swelling test; severe mechanical damage.
Fig. 11—Swelling test; undamaged hair.
Fig. 12—Swelling test; damaged by lumen-invading fungus.
Fig. 13—Swelling test; undamaged hair.
Fig. 14—Swelling test; damaged by lumen-invading fungus.
Fig. 15—Swelling test; damaged by *Aspergillus niger*.
Fig. 16—Congo Red test; damaged by *Aspergillus niger*.
Fig. 17—Congo Red test; damaged by lumen-invading fungus.
Figs. 18 to 21—Congo Red test; damaged by heat.

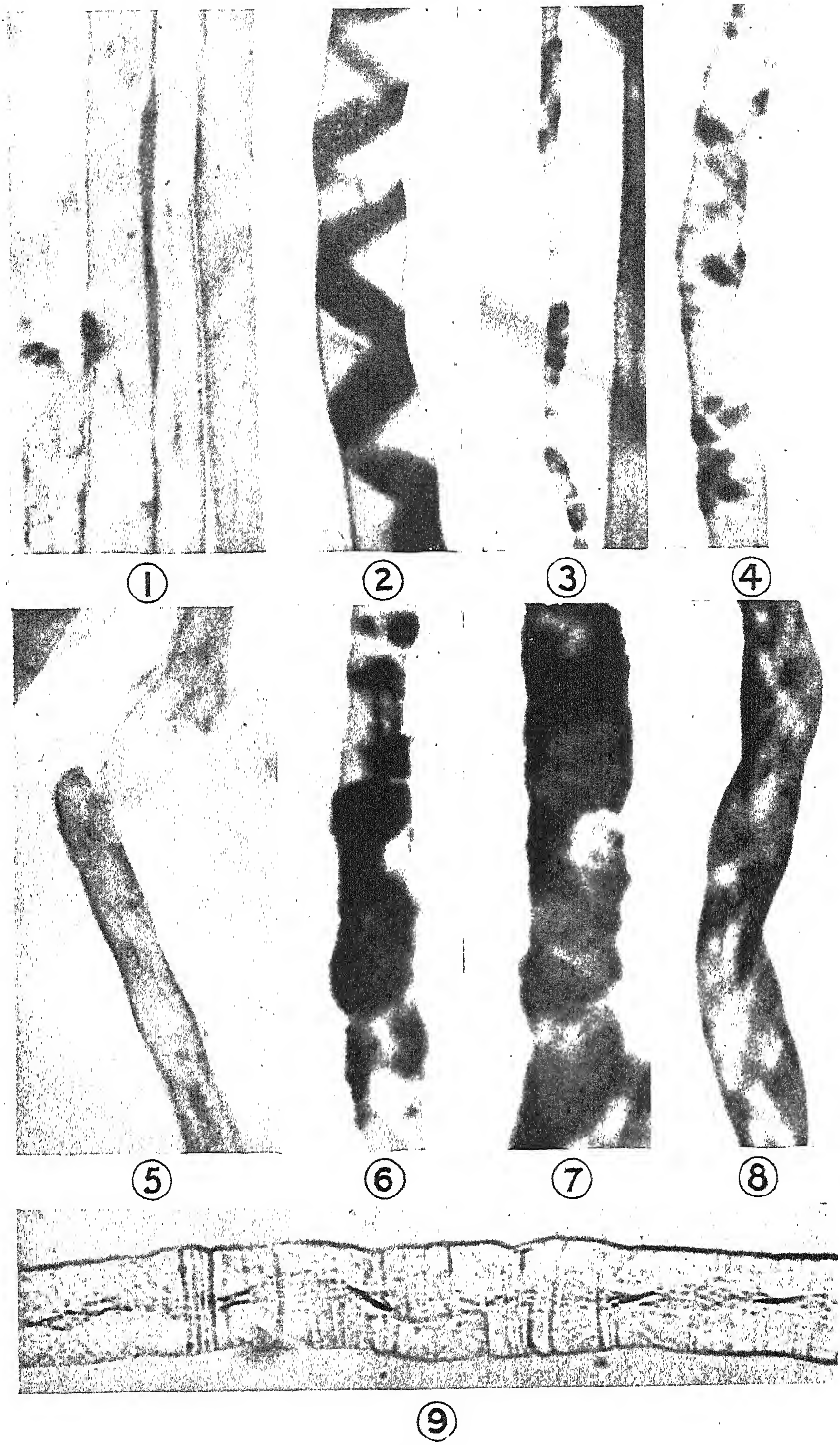


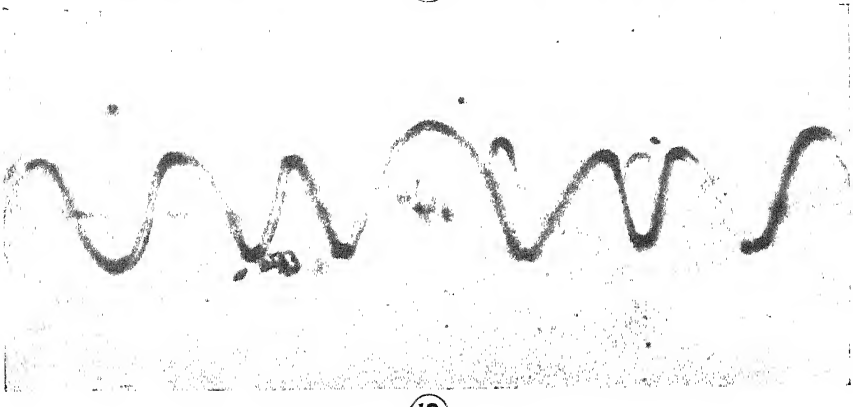
PLATE I.

(10)

(11)

PLATE II.

(12)



(13)

PLATE III.

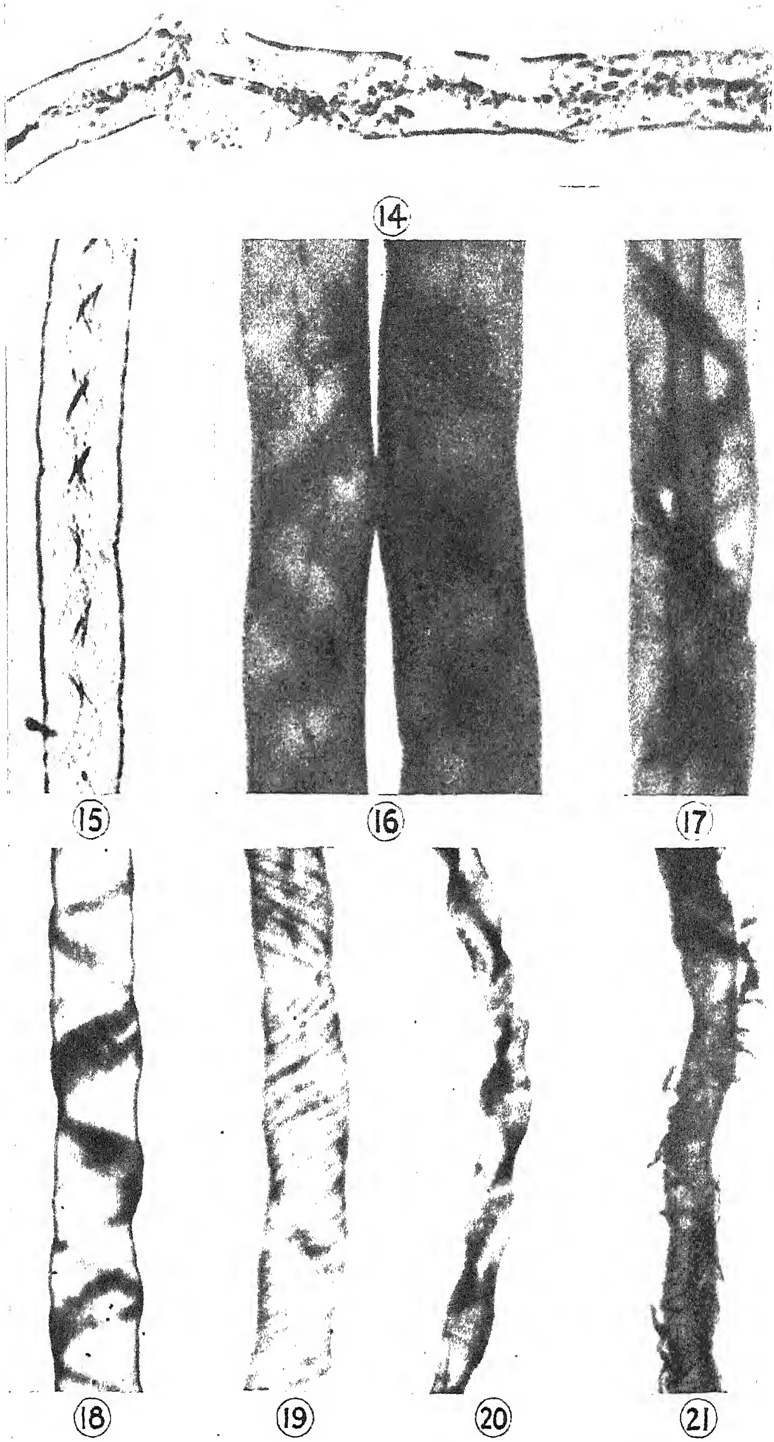


Plate IV.

38—THE BREAKDOWN OF FLAX FIBRE STRANDS DURING THE PREPARING PROCESSES

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A considerable amount of work has been done on the breakdown of flax fibre strands during the preparing processes for wet spun yarn, using the sorting machine and methods described in an earlier publication.* Previous work had shown that during the progress of the fibre from spreadboard to rove, extensive changes in the dimensions of the fibre strands take place, both in length and cross section, but there were not sufficient data to determine which particular features were most important, and therefore of most interest to measure.

The object of this work was twofold—

(1) To investigate the relative importance of length and of cross section or fineness of fibre strand and of the fibre distribution, as regards the spinning quality of the fibre.

(2) To study in detail the manner in which the breakdown occured, and to determine whether the breakdown was a feature of the fibre or of the machinery, and if the latter, what factors were operative.

The answer to (1) would then indicate the lines along which to work to bring about improvement in the behaviour of fibre in spinning, whilst the answer to (2) would possibly indicate some means of bringing about the desired change. In consequence the paper has been divided into two parts dealing respectively with the above heads.

PART I.

A detailed study was made of the change in fibre dimensions, both length and cross section, at each stage of the preparing process from the spreadboard to the rove, which in future will be referred to as the "system," following the ordinary trade practice. All samples tested were representative of the ordinary mill practice unless otherwise stated, that is the fibre was being worked in the way considered most suitable for its class. The samples were designated by the lea of the yarn to which the rove was to be spun, and only fibres for wet spun yarns were dealt with.

The method adopted was to take a sample of sliver leaving the spreadboard, doubler, first drawing and so on, and of the rove. These were then tested on the sorting machine, group selections being made at 2-inch intervals; determinations were made of the mean cross section of fibre strand in each selected group and the average cross section of the total sample, as well as the percentage distributions by weight and by number, weight mean length of fibre in sample, and true arithmetic mean length of fibre. From these results the progress of the breakdown of the fibre strands during the passage of the fibre over the various machines comprising a system was studied. This was repeated on 14 different systems each working its usual class of fibre, so as to cover a wide range of sorts, for example Courtrai and Irish flaxes for several leas of line yarn, Russian flax for line yarn, Courtrai and Irish tows for yarns of different leas, and Courtrai and Irish rescutched tows for combed tow yarns.

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* J. A. Matthew and G. F. New, *J. Text. Inst.*, 1925, **16**, T197–T208.

The results for one system are given in full and the various methods of presenting them are discussed, but for the other systems only such results are given as appear necessary to demonstrate differences found in behaviour. These are tabulated and shown graphically as far as possible.

DETAILED STUDY OF BREAKDOWN THROUGHOUT A LINE SYSTEM

Flax used—Courtrai long line sorted for 50's lea warp yarn.

Experimental Method

The experimental method was to select groups of fibres at 2 inch intervals, a certain number being counted and weighed and the remainder weighed separately. The number counted was increased as the group length decreased, as the total number of fibres in the group increases. From the two weights added together, the weight distribution curve and mean lengths were calculated as already described.* From the ratio of the two weights and the number counted, the total number of fibres in each selected group was obtained by proportion, and calculations of cross section made as follows—

In any selected group

Let N_0=number of fibres counted.

w=weight of counted fibres.

w_1=weight of uncounted fibres.

$W=w+w_1$=total weight of fibres in grams.

Then N=total number of fibres.

$$=\frac{W}{w}N_0$$

Let L inches=mean group length of fibres.

Then if d=density of fibre,

a=mean area of cross section of fibre strands in group in sq. cms. (subsequently called the "mean group cross section") we have—$a\ d\ NL\ 2{\cdot}54=W$

$$\therefore a = \frac{W}{2{\cdot}54\ NLd}$$

Now in order to obtain the absolute cross sectional area, we must know the density of the fibre. This was not determined in each case, but a general value of 1·50 has been adopted in the following work. The density of different sorts of flax will vary slightly from this figure, but the differences are small; comparisons between different sorts will therefore be affected to this extent, but comparisons at different stages of the process where the same sort of flax is concerned, will not be affected by the value taken for the density.

$$\therefore a={\cdot}263\frac{W}{NL}\text{ sq. cms.}$$

To obtain the mean cross section of all the fibres of different lengths in the sample, a weighted mean was obtained in the following way—

Let a_1=mean cross section of all fibres in the sample (subsequently called the "average cross section"),

$$\text{Then } a_1=\frac{\xi Na}{\xi N}=\frac{{\cdot}263\,\xi\frac{W}{L}}{\xi N}\text{ sq. cms.}$$

* *Loc. cit.*

In considering the first system in detail, the results for the percentage of fibre of each length by weight and by number, the mean group cross section and weight mean length, true mean length, and average cross section of the fibres in the whole sample, in each of the slivers leaving the successive stages of the preparing system from the spreadboard to the roving are presented in various ways in diagrams 1–6.

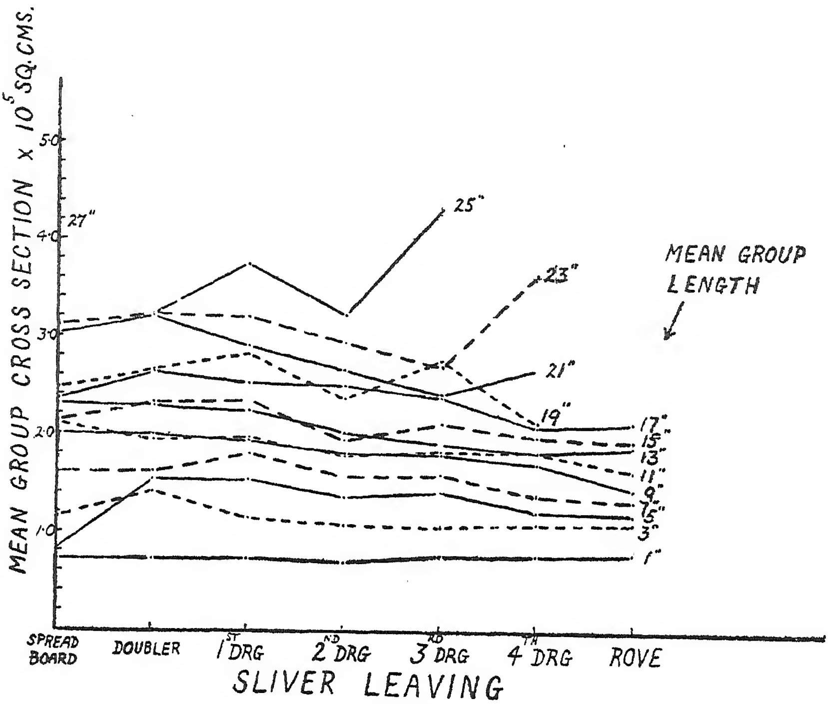

DIAGRAM 1.

Discussion of Results

In diagram 1 the mean area of cross section of fibres in each group is shown at the various stages of the system. It may be noted that the fibre of 1 inch mean group length, subsequently referred to as 1-inch fibre, does not appear to alter appreciably in cross section throughout the system, whilst other lengths up to 21 inches all show a progressive decrease in cross section. The results for fibres of 19 inches and over are more erratic than the majority, no doubt because of the small number present. On the whole the cross sections lie in the order of length of fibre : there are more exceptions to this in the spreadboard sliver than elsewhere, probably because sampling errors would be much greater in this case, as the number of doublings is so small at this stage.

Diagram 2 represents the same results in another way, as here the mean group cross section is plotted against the mean length of the group for slivers from the doubler, the second drawing, and the roving. The other stages are omitted to save confusion. The curves lie in the same order as the stages occupy in the system, but they all tend to join at the 1-inch length, showing that the fibre of each length progressively decreases in cross section, but the

change in the case of the 1-inch fibre is very small. Also the graphs show clearly that the fibre strands are coarser as the length increases.

In diagram 3b, the changes in weight mean length, true mean length, and average area of cross section are shown after each stage in the preparing. It will be seen that each operation causes a decided decrease both in length and cross section of fibre; in this case the mean length and average cross section have been reduced to approximately one-half and two-thirds respectively. The true mean length is approximately one-half of the value of the weight mean length, but the ratio is not constant throughout; for the purposes of such comparisons as these, however, it does not matter which value is considered, and in this paper the weight mean length is generally adopted.

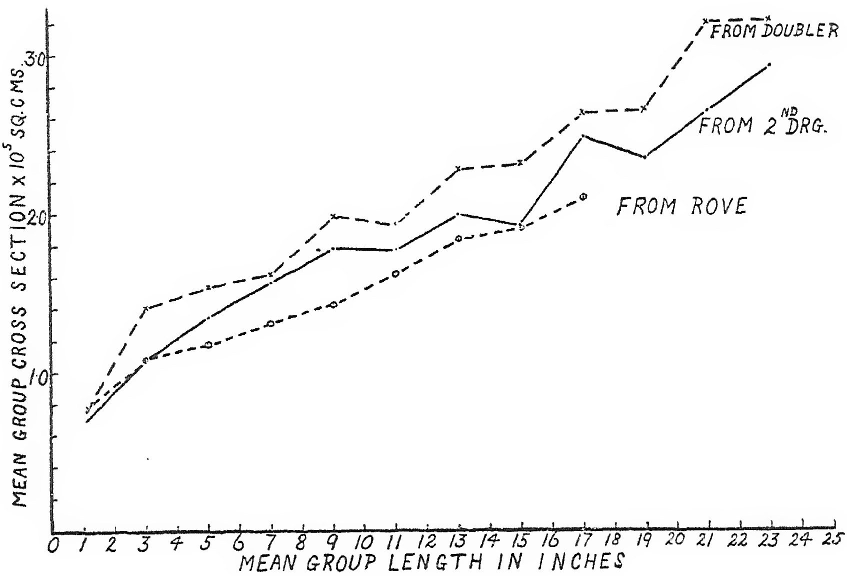

DIAGRAM 2.

In diagram 3a, the average cross section of the fibre in the sample is plotted against the mean length of the fibre after each stage in the preparing; the graph therefore represents the rate of change of cross section with change of length. The experimental results are marked by the crosses on the right of the figure. To decide the type of smooth curve to be drawn throughthese points, we must consider the extreme point on the curve. Obviously there must be some finite limiting value, for example, the cross section of the ultimate fibre; it was shown above, however, that the cross section of the 1-inch fibre shows remarkably little change during the preparing, so it appeared that this was the limit of fineness to which the flax fibre strands can be broken down by an indefinite amount of preparing on machinery of the present type. For the curve shown in diagram 3a, therefore, the cross section of the 1-inch fibre was also plotted and this point connected with the crosses on the right by a smooth curve as shown. In some later cases it was found that the mean group cross section of the 1-inch fibre may tend to fall and then to rise again to its original value; in these cases the fall and rise was always found to be gradual, so it was concluded to be a real effect and not an irregularity due to sampling, and could be explained as due to a transverse

breakage of short lengths from long coarse fibres. In such cases the minimum value of mean group cross section found for the 1-inch fibre throughout the system was regarded as the limiting value to be taken for diagrams such as 3a.

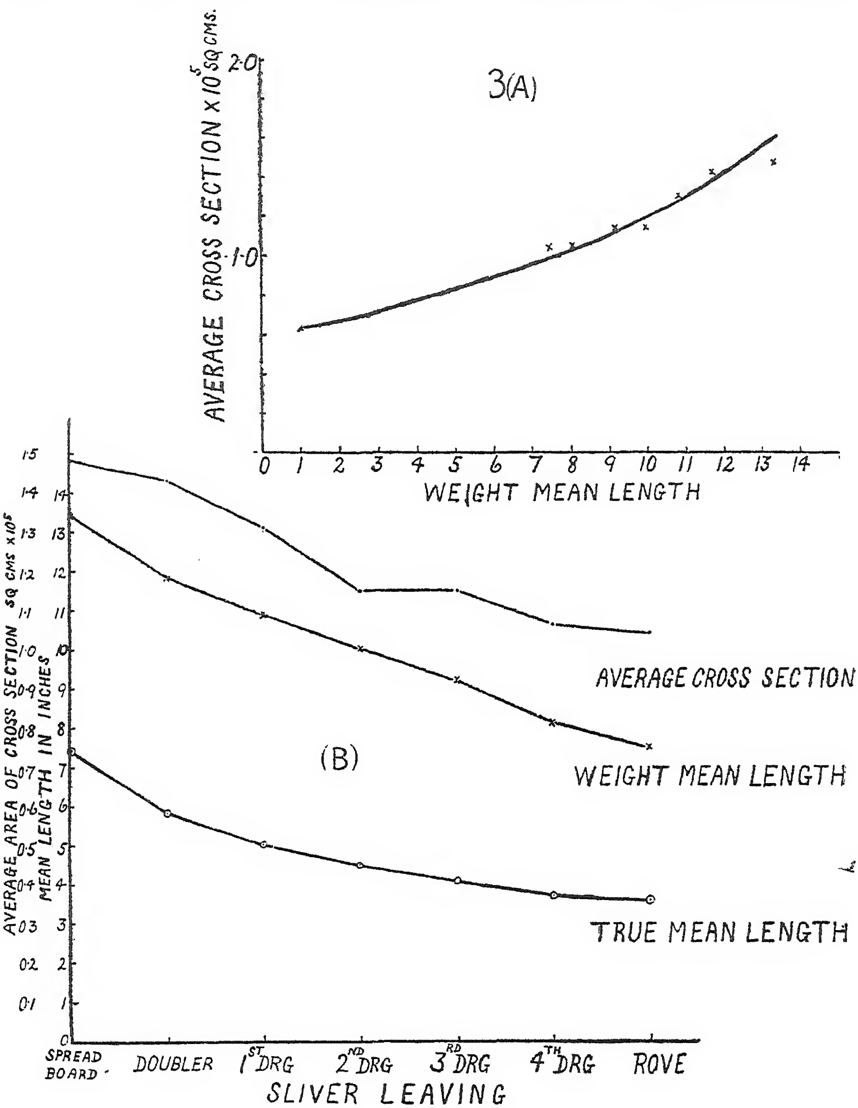

DIAGRAM 3.

Diagram 4 shows how the fibre length distribution curves (estimated as percentage of total weight) vary with the amount of preparing. Alternate stages are omitted to save confusion of the diagram. It will be seen that there is a progressive moving of the curves to the short length side of the diagram, accompanied by an increase in the height of the curve. That is, each drawing causes a reduction in the percentage weight of long fibres and of course, a corresponding increase in the percentage of shorter fibres, and the fibre becomes more and more uniform in length. With this type of graph it is confusing to plot too many curves on the same diagram, so in order

to show graphically the results at all stages, diagram 5 was prepared, and it is preferable in many ways for the purpose of studying results over a whole system. This diagram (5) shows the percentage by weight of each individual group at the successive stages of the system. Up to a mean group length of 7 inches all the groups show an increase in percentage, the 3-inch and 5-inch groups increasing rather more rapidly than the others. The 9-inch group increases up to leaving the first drawing and then remains fairly constant, the 11-inch group shows a slight rise followed by a fall, the 13-inch group remains constant to the first drawing and then falls, whilst all the longer groups may be said to show a progressive decrease in percentage throughout the system.

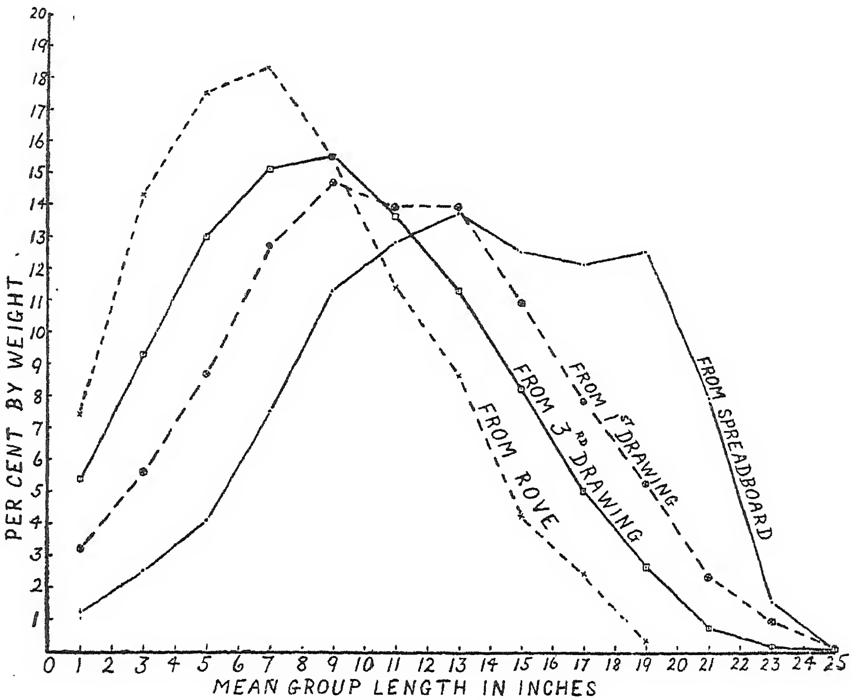

DIAGRAM 4.

Diagram 6 shows in a similar way the results for percentage by number (that is, the number of fibres in each group as a percentage of the total number of fibres in the sample) of each individual group at the successive stages of the system. For a mean group length of 7 inches and over, each group shows a gradual decrease in percentage number as the roving is approached. A length of 5 inches appears to be a sort of transition stage, as the results vary around a constant figure, but both the 1-inch and 3-inch groups show very pronounced increases, both being much greater than for any other single group. The rate of increase in these two groups are characteristically different, because whereas the 1-inch group gives a very rapid rise on leaving the doubler, followed by a continuously decreasing rate of increase, finally approaching a constant value after the fourth drawing, the 3-inch group shows a fairly rapid and uniform rate of increase throughout.

This last diagram appeared to be very interesting and suggests an explanation of the method of breakdown. It was shown in diagrams 1 and 2 that the fibre in each length group is reduced in cross section after each drawing.

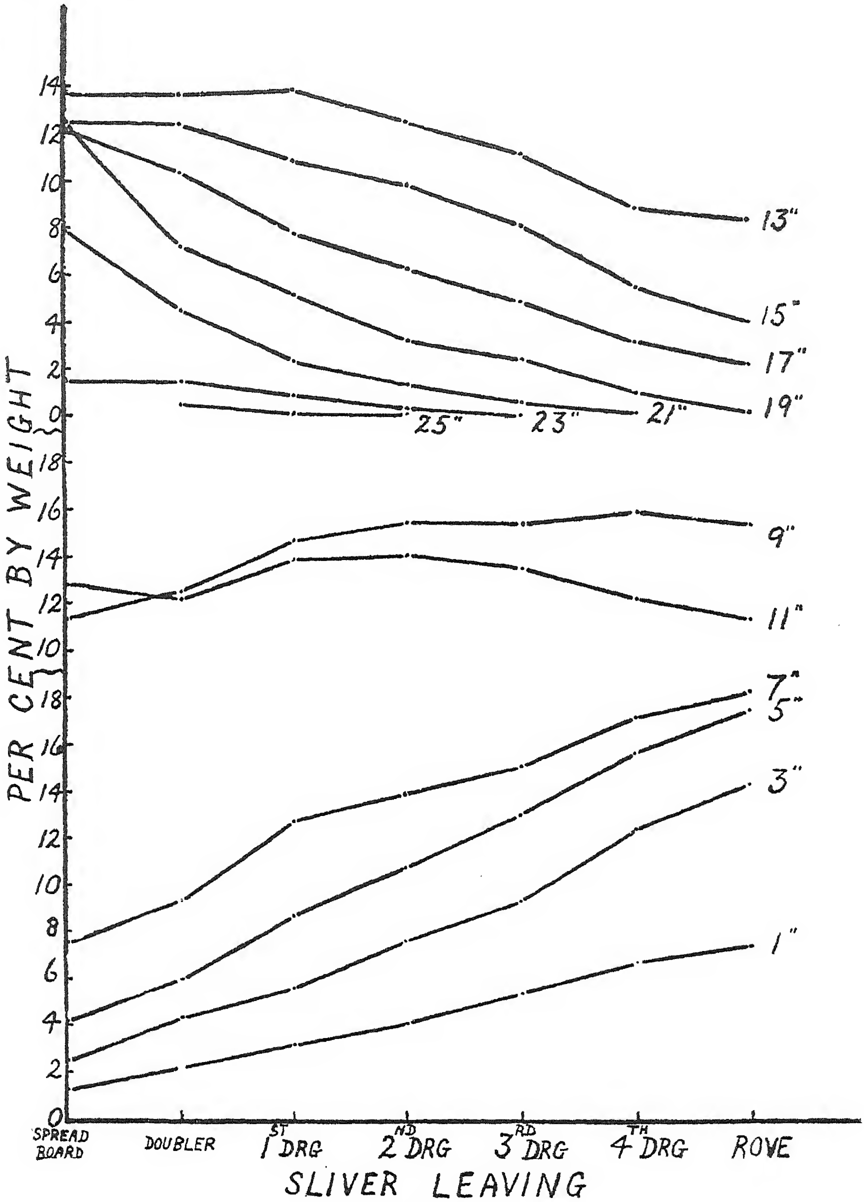

DIAGRAM 5.

Now in diagram 6 we see that the numbers of 1-inch and 3-inch fibres increase at a much greater rate than the number of long fibres decrease. Therefore the conclusion is that a good proportion of these 1-inch and 3-inch fibres are produced from the long fibres without causing any reduction in their effective length, that is that they are short pieces stripped or peeled off

the sides. The initial rapid rise in percentage number of 1-inch fibre also suggested that they might be produced by the first few drawings pulling or breaking off short lengths as the ends of the fibres might be expected to be

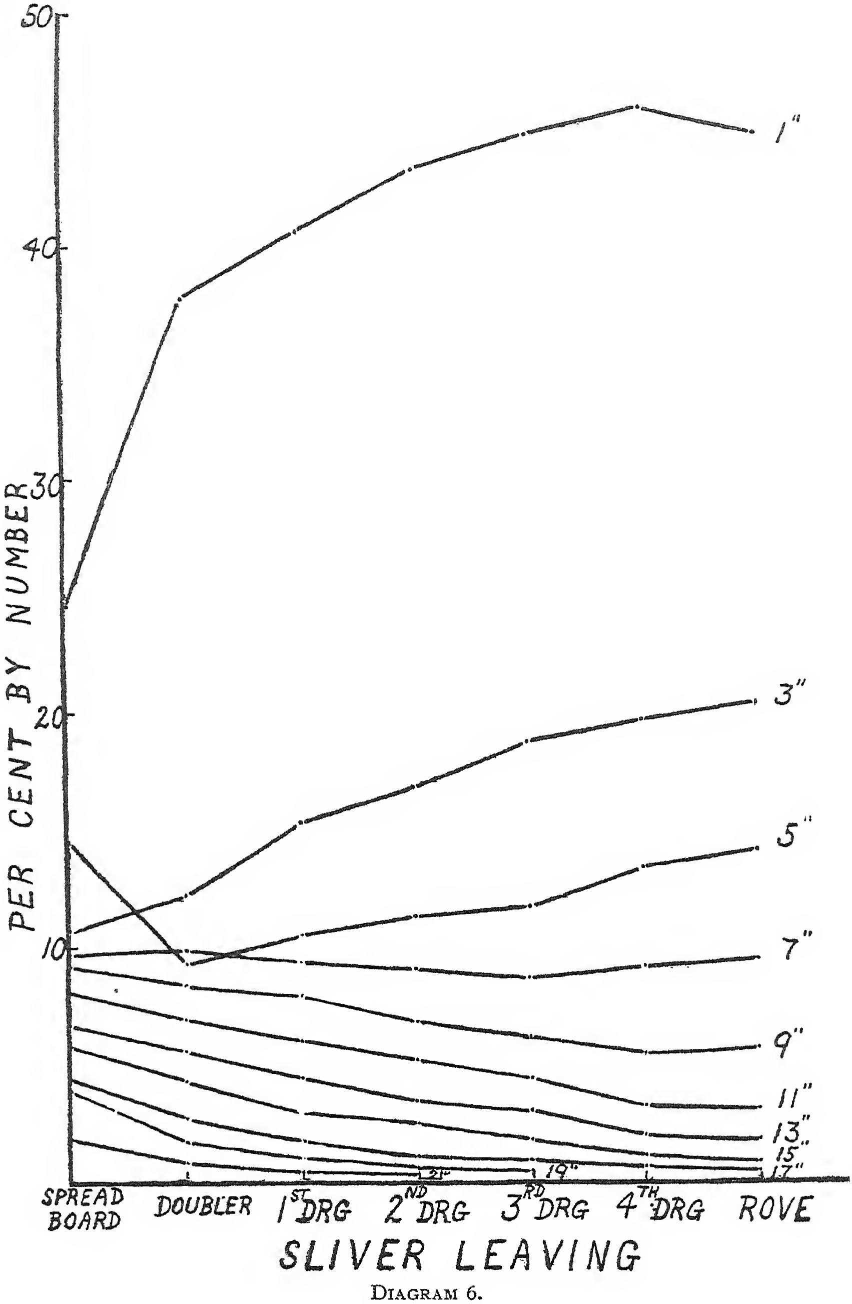

DIAGRAM 6.

fine and weak. An attempt to trace such an effect has been made by including cut line in the following measurements, as then weak ends should be mostly removed by cutting.

Conclusions

From this detailed study of the fibre dimensions after each stage of the preparing system, the following conclusions and suggestions may be drawn. That with this Courtrai long line fibre—

(1) The average length and the average cross section of the fibre is reduced continuously during its passage over each of the various drawing frames.

(2) The mean group cross section of each length of fibre is reduced by each successive drawing, but the cross section of the shortest fibre (1 inch) remains practically unaltered throughout the system.

(3) When the average cross section is plotted against weight mean length, after successive drawings, a smooth curve is obtained which passes through a point which represents the cross section of the 1-inch fibre, which is regarded as the limiting fineness to which the fibre can be broken down by this preparing process.

(4) The fibres from the successive stages not only become shorter on the average, but the variation in length becomes smaller and smaller.

(5) A study of the changes in percentage number of fibres, in conjunction with the previous conclusions, suggests that the 1-inch and 3-inch fibres may be very largely produced by a peeling off of side branches from the long fibres, and there is also a suggestion that some 1-inch fibre may be produced in the earlier stages as a pulling off of weak ends from the fibre strands.

FLAX LINE SYSTEMS: VARIOUS KINDS AND QUALITIES

In order to see how far these results might be typical, and to investigate the suggestions mentioned above, a number of other line systems were examined in the same way, as follows—

(1) Courtrai cut line for 180's lea yarn.
(2) Courtrai long line for 160's lea yarn.
(3) Courtrai long line sorted for 50's yarn, as already described, given five extra drawings on doubler and an additional drawing on the first drawing frame, a suitable number of doublings being given every time to keep the weight of sliver correct.
(4) Irish tipples for 70's lea weft yarn.
(5) Irish tipples for 35's lea warp yarn.
(6) Russian tipples for 60's lea weft yarn.

Nos. (1) and (2) were not carried out on the same sort of flax which would have been necessary in order to obtain an exact and direct comparison on the effect of cutting the flax line. As the same sort of flax as used in the 180's cut line was not available at the time, the nearest available sort was taken and there would be a difference of about three grades between the two sorts. Comparison of No. (3) with the 50's described above in full gives the effect of extra preparing. (4) and (5) were intended to compare different sorts of Irish flax, whilst (6) permits of comparison between Courtrai, Irish, and Russian flaxes.

The results are too numerous to give in full for each system, as was done in the first case, so only those dealing with the various points under discussion will be presented. The figures are shown graphically in diagrams 7—11, which also show for direct comparison the results given above for 50's Courtrai. It is not intended to discuss the results system by system, but to compare the various sorts of flax and systems from the various standpoints raised by the discussion on the results of the system given in the previous section.

Discussion of Results

The *change in mean length* of the fibre is shown on the left of diagram 7, in which the ordinate scales are moved to keep the various curves distinct. The bottom two curves show the reduction in length at successive stages of Courtrai flax, Cut line, and Long line of somewhat similar sorts. The Cut line is a good deal shorter than the Long line on leaving the spreadboard, but this difference is eliminated after passing over the doubler, and then throughout the rest of the system the differences are small, with the Long line

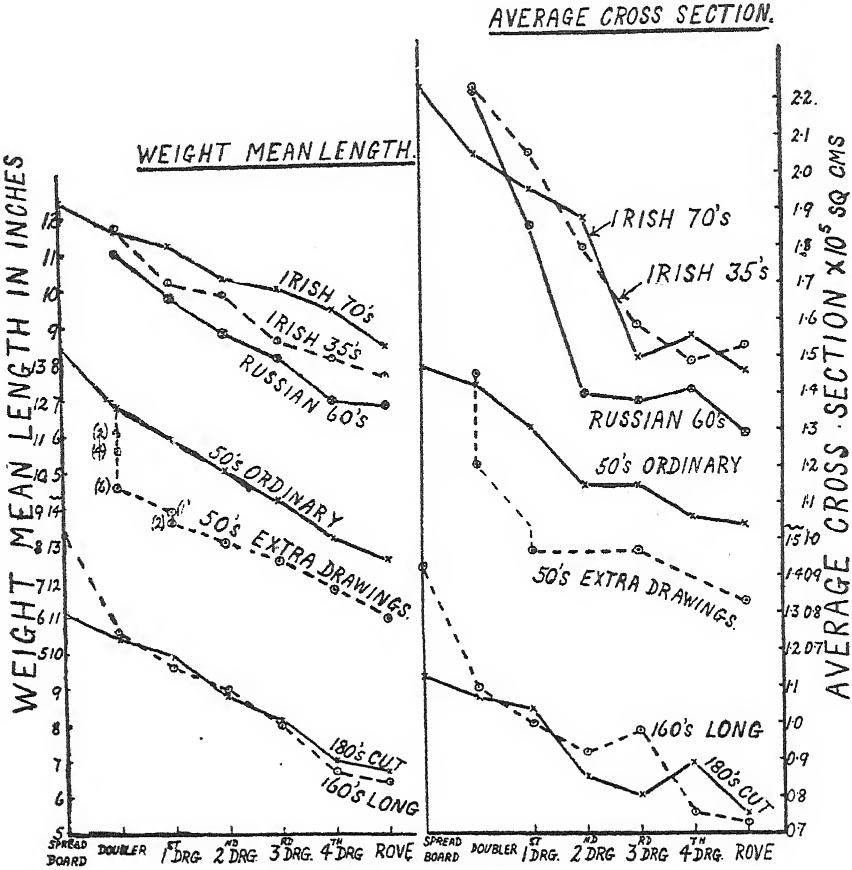

DIAGRAM 7.

ending up slightly shorter than the Cut line. Over the whole system, therefore, the Long line showed a greater amount of breakdown than the Cut line.

The middle pair of curves shows the effect of extra preparing on Courtrai Long line (sorted) for 50's warp yarn. The same kind of flax fibre was used in both cases, the extra preparing given was five times over the doubler and once extra over the first drawing, in all cases the doublings being arranged to keep the weight of sliver normal. The changes of length after two, four, and six times over the doubler are shown one below the other, similarly after one and two times over the first drawing. From then on the normal preparing was followed. It will be seen that there is still a decided decrease in

length after each drawing, although on leaving the first drawing the rate of decrease is not quite so great as in the ordinary system. The total reduction in length of fibre is rather greater for the 160's than for the 50's Long line Courtrai.

The top pair of curves shows Irish flaxes, a 70's weft and a 35's warp. In both cases a continuous decrease is shown, and in both cases this reduction is less than for Courtrai line, especially in the case of the 70's Irish, which

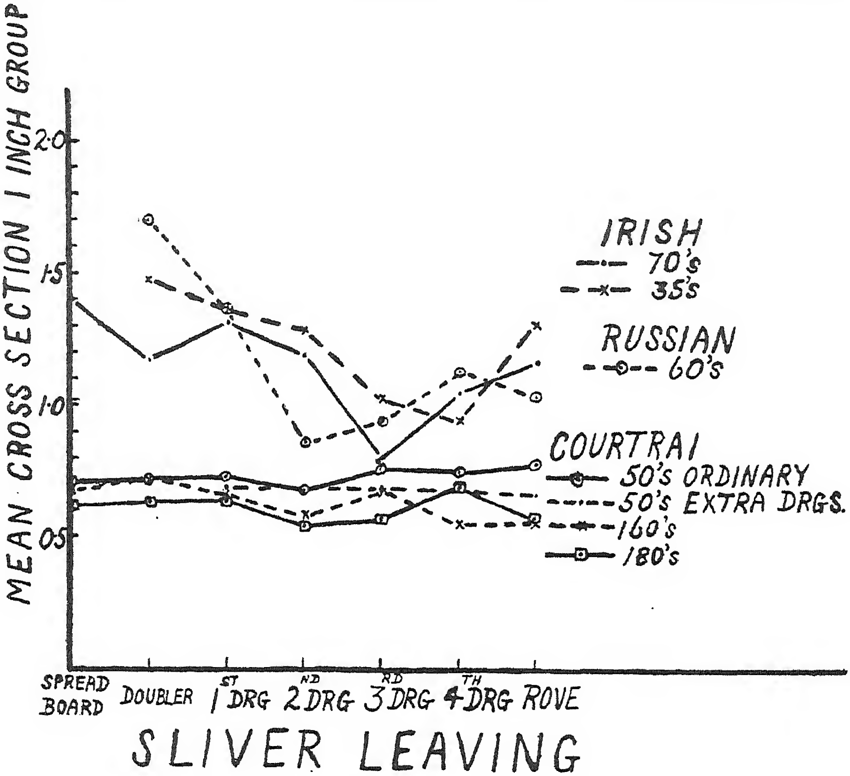

DIAGRAM 8.

is approximately the same as for the 180's Courtrai Cut line. The Russian flax is compared on the same scale as the Irish; the fibre appears to be shorter to start with and remains shorter throughout the system, the rate of breakdown being about the same as for the 35's Irish. The length of fibre in the rove is shorter than for Irish or Courtrai of the same lea.

The *change in average cross section* of the fibre is shown on the right of diagram 7. The four Courtrai curves are relatively almost the same as those for mean length. The 160's Long line shows a greater total reduction in average cross section than the 180's Cut line, and although the 160's is coarser on leaving the spreadboard, it is very slightly finer on leaving the roving. There is also an indication that over the last few drawing frames, the rate of reduction in cross section becomes smaller than in the early part of the system. This feature is more pronounced with the 50's Courtrai which was given the extra preparing; in this case, after leaving the first drawing frame, the rate of decrease of average cross section becomes very small.

This feature is again very marked in both the Irish flaxes, and in the Russian flax. In these cases it can be said that the change in cross section after the third drawing is negligible compared with the total reduction. There was very little difference in cross section between the 70's and 35's Irish after the first drawing and both were much coarser than the 50's Courtrai.

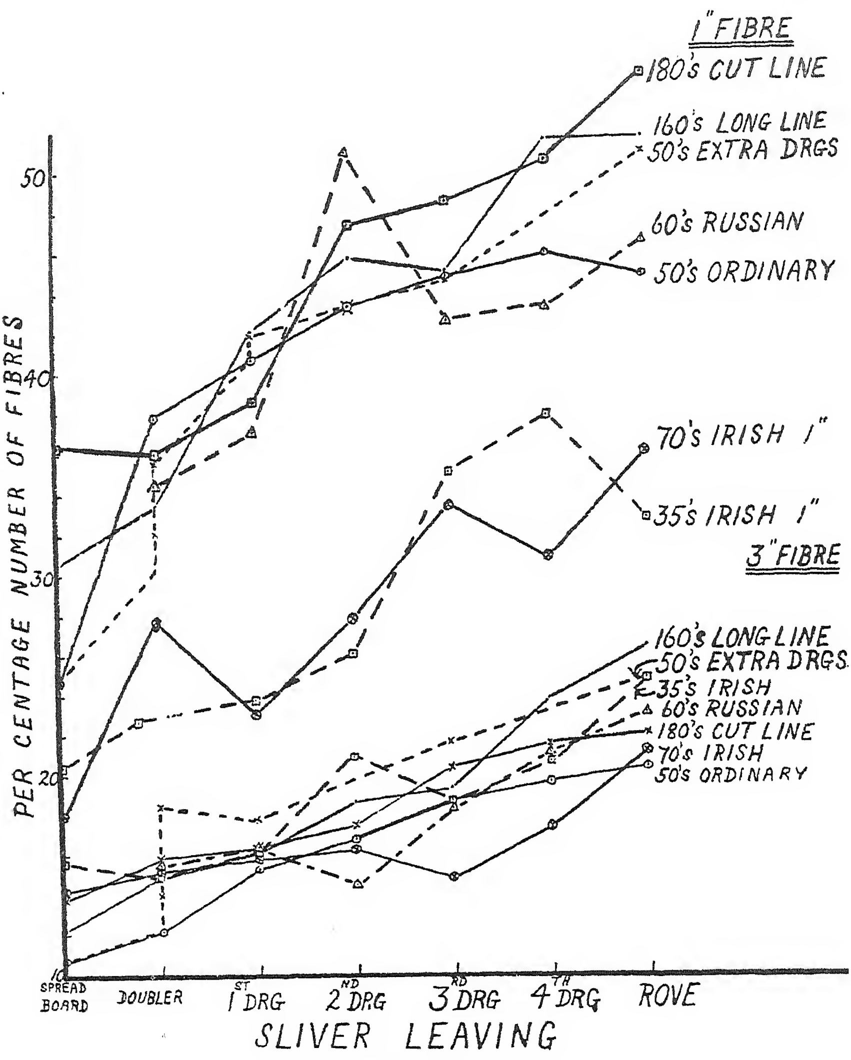

DIAGRAM 9.

The 60's Russian flax started with about the same cross section as the 35's Irish, and ended up considerably finer, but still much greater than the 50's Courtrai. The initial rate of change of cross section was much higher in Russian than in Irish.

The change in mean group cross section of the 1*-inch fibre* throughout the system for each of these flaxes is shown in diagram 8. In the system dealt with in full, it was remarked that the cross section of this fibre appeared to remain practically unaltered. This is very substantially confirmed in the

case of Courtrai flaxes, for which it will be seen that the variations are very small. The case of the 50's Courtrai with extra preparing is very interesting in this connection, as the minimum mean group cross section of 1-inch fibre in this case is practically the same as in the ordinary system, in spite of the six extra drawings. This appears to indicate that this dimension is purely a factor depending on the flax fibre.

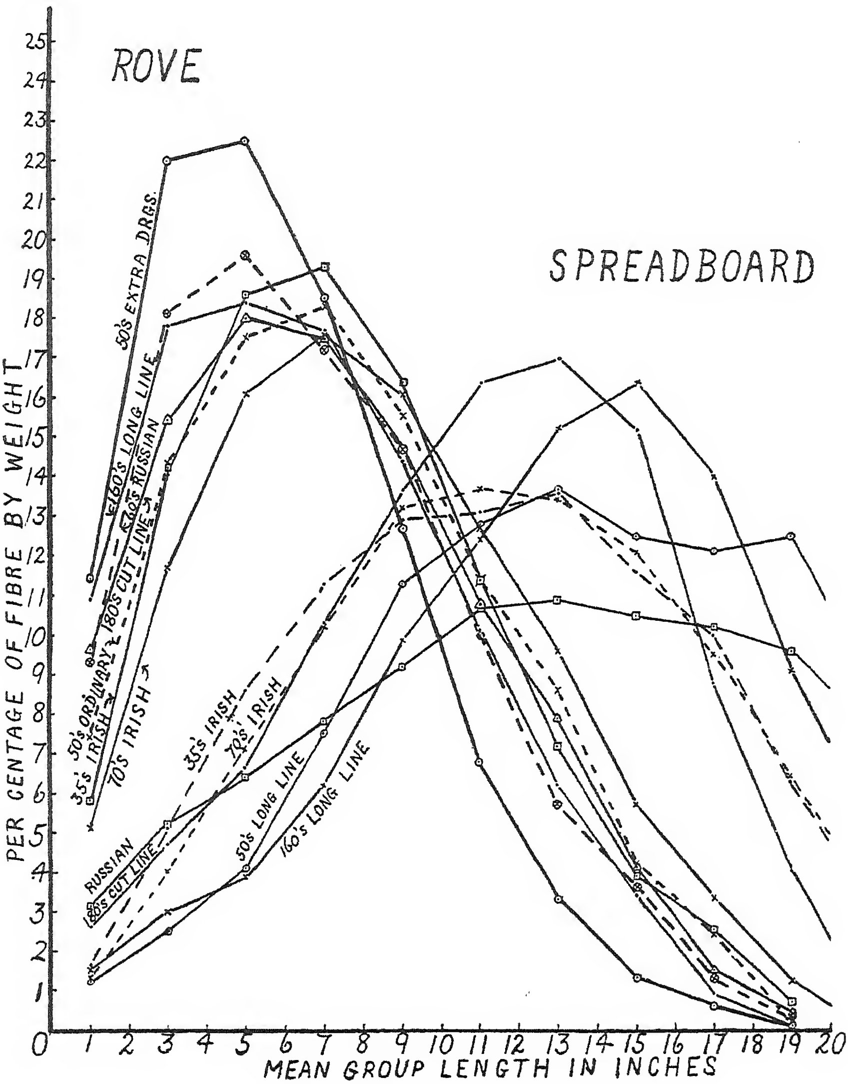

DIAGRAM 10.

With the Irish and Russian flax fibre, the mean group cross section of 1-inch fibre undergoes considerably greater changes than that of Courtrai flax. In each case the cross section shows a gradual decrease followed by a gradual rise.* This means that during the first few drawings the 1-inch fibre produced is finer in cross section than that in the original flax, but afterwards the 1-inch fibre produced is of greater cross section and so increases the mean.

This appears to indicate that some breakage of long fibres, which have been shown to have greater cross section, takes place. This is also consistent with the behaviours shown on diagram 7, in all cases a continuous decrease in mean length, but with Irish and Russian the decrease in average cross section almost ceases after the third drawing, whereas with the Courtrai flaxes it is still decided, although somewhat less. It would be expected that this behaviour, that is, whether the fibre strands become broken off to give short coarse pieces, or continue to the end of the preparing to give only short fine pieces, would be intimately connected with the tensile strength of the fibre strands, but no measurements on this point have yet been made.

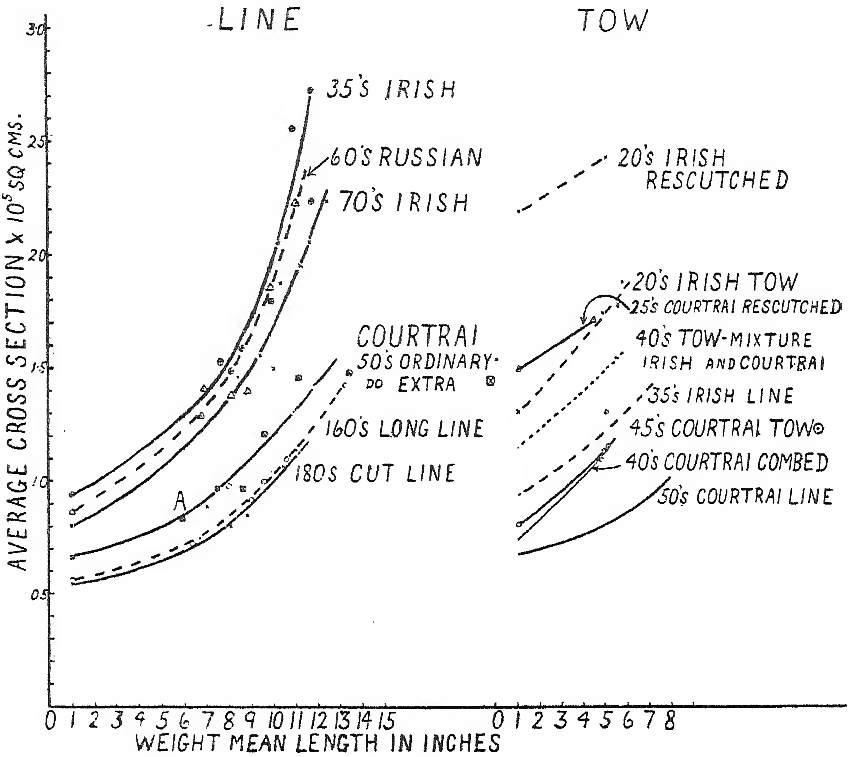

DIAGRAM 11.

The change in percentage of total number for 1-inch and 3-inch fibre at each stage of the system is shown in diagram 9. There appeared to be no real difference in any case in the general behaviour as regards fibres longer than 3 inches in length, so they are not shown. This type of diagram was shown to be of possible interest as affording a means of elucidating the method of production of the short length fibres, particularly that of 1-inch mean group length. It was seen in the case of 50's Courtrai Long line (also again reproduced on this diagram) that the percentage number of 1-inch fibre showed a very rapid rise at first and then gradually decreased. It was thought this was consistent with an explanation of weak ends being pulled off in the drawing, and this has been investigated by testing a system employing Cut line, in which a large portion of these weak ends should presumably have been removed before being used. It will be seen that this

system, 180's, gave an entirely different type of curve, the percentage of 1-inch fibre showing only a very small change until the second drawing, after which the increase was fairly continuous. This flax was of a considerably finer sort than that used in the 50's, so the measurements were repeated on 160's Long line, thus employing a flax which, although of a different sort from that in the 180's, did not differ so much as that of the 50's Courtrai. With the 160's Long line, as in the 50's, the percentage of 1-inch fibre increased at once and continued fairly rapidly throughout the system. The results, therefore, appear to show a decided difference in behaviour between Long line and Cut line, and therefore provide some evidence of the correctness of the explanation that at least some of the 1-inch fibre is produced by being pulled off the ends of the strands.

The curves for the Courtrai flaxes lie close together, broadly speaking in order of the lea of yarn, the finer the yarn the greater the percentage number of 1-inch fibres. The Irish flaxes give very similar results to each other, but very different from the Courtrai, containing 10–20% fewer of these short lengths, both in the original and in the rove. The Russian flax appears to resemble Courtrai in respect of the number of 1-inch fibres present.

In regard to the percentage number of 3-inch fibres, the differences between the different sorts of flax found with 1-inch fibres do not appear to exist in such a marked manner. A range of 5% at any stage covers all the various sorts. The differences between the various kinds of flax do not show out distinctly, so they must be less important as regards the production of 3-inch fibre than other factors, such as particulars of the preparing systems, &c.

Fibre length weight distribution curves for the roves and the slivers leaving the spreadboard (below 20 inch length) are shown in diagram 10. The curves for normal roves are seen to be very similar in type, rising steeply to a maximum and then falling away fairly steeply. There does not appear to be any striking difference in the maximum value for the percentage weight. If the position of the peak, that is the mean group length at which the maximum percentage occurs, can be regarded as any criterion, there appears to be two classes; the first has a majority of fibres of 5 inches in length and includes the finer Courtrai flaxes and the Russian, whilst the second, including the Irish and coarser Courtrai flaxes, has a majority of fibres of 7 inches in length. It cannot be said at present whether this has any decided significance; in the meantime it should not be stressed unduly, because it has been found that the position of this peak may vary as much as 2 inches in repetitions on the same sample, as previously described.* It may be remarked, however, that these two groups, when differentiated in this manner, show a decided difference in the percentage weight of fibre of 1 inch length; the Irish flaxes contain only one-half as much as the finer Courtrai and Russian flaxes.

The rove curve for the 50's Courtrai with the extra preparing, is of the same type as that of the finer Courtrai flaxes, but is again quite distinct, because it has a much higher maximum percentage value and a noticeably less amount of the longer fibres, whilst the amount of 1-inch fibre is not greatly increased. That is to say, the extra preparing mainly produces fibres of 3 and 5-inch lengths, and produces a rove with less variation in length than is the case in, say, 160's rove. Generally these results are of a similar character to those found from consideration of the percentage number,

* *Loc. cit.*

except for a change in the order as regards the amount of 1-inch fibre; this is brought about because the weight of fibre takes into account the cross section of the fibre, as well as the number.

The curves for distribution of fibre lengths in the spreadboard slivers show considerable differences. The effect of cutting is clearly evident as a shift of the whole curve towards the shorter lengths. There is a noticeable difference in the curves for 50's and 160's Long line Courtrai, the latter having a sharper peak, denoting greater uniformity in the fibre lengths. The curves show very clearly that on leaving the spreadboard, the percentage weight of 1-inch fibre is the same in the Irish and Courtrai Long line, so the considerable difference found in the roves is a characteristic of the different behaviour of these flaxes on the preparing machinery. In this respect the Russian flax resembles a Cut line, containing twice as much 1-inch fibre as in Long line, but in the roves the amounts are about the same as for the Courtrai Long line, so that the Russian flax and the Courtrai Cut line flax do not make so much in the course of the preparing.

The change of average cross section with weight mean length in these cases is shown in diagram 11, the value of average cross section marked at the 1-inch group length being the minimum mean group length found throughout the system. A few considerable irregularities occur, but the smooth curves shown appear to represent the experimental results very fairly. It will be seen that a family of similar curves are obtained, and that the curves for Courtrai flaxes lie in a group well below the group for Irish flaxes, which also contains the Russian flax. The curves for Irish and Russian flaxes appear rather different from those for Courtrai flax, having a steeper slope, denoting that the rate of decrease of cross section with decrease in length is more rapid with these flaxes than with Courtrai. This of course was also indicated by the results shown on diagram 7, but not in so direct a manner.

In each group, the coarser the yarn to which the fibre was to be spun, the higher is the curve in the series.

The 50's Courtrai with extra preparing is of interest in this connection, as the extra drawings had the effect of decreasing the length considerably more than was the case in the ordinary system; the mean length of fibre in the rove of the normal system was 7·5 inches, but with the extra preparing this was reduced to 5·9 inches. This latter case, therefore, gives a point (A) on the curve which considerably reduces the gap from 7·5 inches to 1 inch which was filled in by inspection, assuming the value of the cross section for 1-inch fibre to be the correct limiting value. The new point A appears to lie fairly well on this filled-in portion of the curve, and so tends to justify the above assumption.

SUMMARY OF CONCLUSIONS FROM LINE FLAXES

Although the extent of the above work is very small compared with what would be necessary in order to make an absolutely detailed study of all the various practices, yet the samples selected cover a wide field, and the general behaviours examined are so similar and the results so concordant, that it may be said that they form, if not conclusive, at all events very strong evidence that the following conclusions may be drawn.

(1) With all the line flaxes examined, the mean length of fibre is decreased by each drawing operation, and with Courtrai flax the progressive decrease was found to continue for six extra drawings which were given. The rate

of breakdown in length varies slightly according to the nature and quality of the flax, but with Courtrai Long lines it was found that the finer the lea, the greater was the breakdown. The fibres have longer mean lengths in Irish than in Courtrai roves, which in turn are longer than Russian for approximately the same lea. Cut lines show a less rapid decrease in mean length than Long line of about the same quality.

(2) The average cross section of Irish flax did not show any great difference between the different sorts of 70's weft and 35's warp, but there was more difference between 50's and 160's Courtrai Long line, the 50's being coarser than the 160's. In roves, Irish fibre had the greater average cross sectional area, Russian flax was only a little less, and Courtrai flax was again a good deal finer than Russian. The rate of decrease of cross section shows more marked differences according to the nature of the flax than the breakdown in length. All the results tend to show that in the later half of the system, the rate of change of cross section becomes smaller; with Courtrai flaxes the difference is noticeable but not very large, but with Irish and Russian flaxes, the rate becomes so small as to be almost negligible.

(3) With Courtrai flaxes the mean group cross section of 1-inch fibre shows practically no change throughout the system, or even with a lot of extra preparing. Both Irish and Russian flaxes show a decided decrease followed by a gradual rise. The results are taken to justify the conclusion that the minimum value of mean group cross section of 1-inch fibre is a limit of fineness to which the flax fibre strands could be broken down by normal preparing machinery by an indefinite number of drawings.

(4) Consideration of the rate of change of percentage number of 1-inch fibre is shown to be of interest. The Courtrai flaxes contain decreasing amounts as the yarn lea behomes heavier, Russian contains approximately the same amount (by number) as Courtrai, but Irish flax appears to contain about 15% less than either Courtrai or Russian. A characteristic difference is shown between Cut line and Long line; whilst the former shows a very small increase in number of 1-inch fibre for the first few drawings, the latter shows a rapid and continuous increase right from the spreadboard. This seems to show that the more rapid rate of change of mean length found with Long line is due to the pulling off of short weak ends or some similar effect in the early stages of the preparing, since in Cut line such ends would be removed by cutting.

(5) No general distinction can be made between Courtrai and Irish flax roves as regards the type of the weight-length distribution curves. Russian flax gives the same type as a fine Courtrai, whilst Irish and coarser Courtrai have the same type. Extra preparing alters the type of the curve, to that of a much finer number, and in addition, raises the maximum height and reduces the amount of long fibre considerably, while the amount of 1-inch fibre is increased. The weight-length distribution curves for the slivers leaving the spreadboard show very considerable differences for the different sorts of flaxes, but as already stated, the effect of the normal preparing system appears to be to eliminate these differences very largely by the time the rove is made. Comparison of distribution curves for roves would hardly be expected therefore to offer much data in regard to the possible behaviour on spinning; distribution curves on spreadboard slivers might be more useful in this connection, in conjunction with other measurements.

(6) It was shown that the mean group cross section of fibre of each mean group length (except 1 inch) shows a gradual decrease throughout the system, which appears to indicate that the shorter length fibres produced during the preparing are mainly fine pieces stripped off the sides of the longer coarser strands.

(7) If curves be drawn showing the relation between average cross section and weight mean length, taking the minimum mean cross section of 1-inch fibre as a limiting condition, smooth curves are obtained of a very similar character for all the different line flaxes, only differing in position. Courtrai flaxes give curves close together in one group, whilst Irish and Russian flaxes give another distinct group lying much higher up. In each group the curves lie in order of the lea of the yarn to which the fibre was to be spun, in accordance with usual mill practice.

(8) The fibre dimensions and the nature of the changes which take place during preparing are shown to be quite different in Courtrai and Irish line flax. Taking the rove state for comparison, Courtrai flax is slightly shorter than Irish (7·5 inches against 7·6–8·4 inches) and very much finer in cross section (1·04 against 1·5). Russian flax resembles Courtrai in some characteristics and Irish in others, thus the mean length of fibre in rove is short (6·9 inches), whilst the average cross section is coarse (1·3). Consideration of these results and of curves such as are shown in diagram 11, appear to indicate that the mean fibre length shows less change between grades of similar kinds of flax or between different sorts of flax than the average cross section of the fibre strands, so it would appear probable that the latter is the more important characteristic as regards the spinning quality of the fibre. It may prove on further investigation that the mean group cross section of the 1-inch fibre, or what has been termed the limiting fineness of breakdown, is even more important than the average cross section; at all events it should prove a more convenient means of comparison as the length factor is fixed.

TOW SYSTEMS: VARIOUS SORTS AND QUALITIES

Similar measurements to those described for line systems were made on three tow systems; three combed tow systems were also examined as to change of weight mean length throughout the system, with some measurements of average area of cross section.

The following cases* were investigated—

Tow—(1) For 40's lea yarn—mixture of Irish and Courtrai root tow from hackling machines.

(2) For 20's lea yarn Irish—mixture of roughing tow and tops from the hackling machine.

(3) For 45's lea yarn Courtrai—mixture of roots and tops from the hackling machine.

Combed Tow—(1) For 20's lea yarn—Irish rescutched tow.

(2) For 25's lea yarn—Courtrai rescutched tow.

(3) For 40's lea yarn—Courtrai hackling machine tow.

The results of the analyses of the slivers at each stage of the preparing system are given in full for one tow system in Table I. It is not considered

* In each case the fibre was given the normal preparing considered best from mill experience.

necessary to show the results graphically, as inspection of the table readily shows that the four columns giving the results from first drawing to rove, are practically identical, the differences being of the same order as would be obtained in four repeats on the same material. That is, there is no change of fibre dimensions, either as regards length or cross section after the fibre leaves the first drawing.

On comparison of the means for length and cross section of the fibre leaving the card and the first drawing, it will be seen that an apparent increase in length and cross section is shown on passing over the first drawing. An examination of columns 1 and 2 in each of the sections showing the percentage weight and percentage number, show that there is less weight of fibre of 1 and 3 inches and a fewer number of 1-inch fibres in the first drawing slivers compared with the card sliver. Since there is no fibre lost in passing over the first drawing, this means that fibres which were grouped in the 1-inch group in the card sliver, have been placed in longer groups in the first drawing sliver, that is, fibres which were doubled and curled up in the card sliver have been straightened out on the first drawing frame and so become sorted into their correct lengths. As will be seen by comparing the mean lengths shown in Table II., the same behaviour was found in all the Irish tow systems examined and in Courtrai rescutched tow, but not with Courtrai hackle tow; in this case there was no change with the 45's tow and a slight decrease with 40's combed tow. It would appear therefore that the effect only appears or is more pronounced with very coarse fibres. In a combed tow system there is also an apparent increase in length of fibre on leaving the comb; this, of course, is due to removal of a large percentage of fibre in the noils, a good proportion of which is very short fibre.

It will be seen from Table II. that the rescutched tows, both for Courtrai and Irish are noticeably shorter than the fibre in the tows; the differences in average cross section are still more pronounced. In the tow, the cross section of the Irish is again very much greater than that of the Courtrai fibre, both also being very much larger than the respective figures for line fibre. These remarks also apply to the mean group cross section for 1-inch fibres as shown in the last section of this table. The cross section of rescutched Courtrai and Irish were both considerably greater than for ordinary machine tow, the Courtrai rescutched tow having a cross section approximately the same as the Irish machine tow.

Table III. shows the weight-length distribution in the roves and it will be seen that the chief differences exist in the amount of 1 inch fibre and in the value of the maximum percentage. Whilst the maximum percentage in line roves was found to be between 17·5 and 19·5, the tows give values 26–28·5 and the combed tows 30–37; also the maximum percentage occurs at a mean group length of 3 inches for combed tows and 5 inches for tow and 5 or 7 inches for line. Each class of fibre therefore appears to have a distinct type of distribution curve, but the differences which exist between different sorts of fibre in the same class appear to be unimportant in comparison with the difference between the types.

The results for weight mean length and average cross section for these tows are shown to the right of diagram 11*, the corresponding curves for line flaxes of Irish and Courtrai of the nearest yarn lea being also inserted from the left-hand side of the diagram. The Courtrai flax curves are all drawn in full line, while the Irish flax curves are all dotted, to permit of easy discrimination.

* See Author's note on page T434

Table I.

Flax.—Irish and Courtrai Root Tows from Hackling Machine, for 40's Lea Yarn.

Mean Group Length	Per cent. by Weight in Sliver from					Per cent. by Number in Sliver from					Mean Group Cross Section $\times 10^5$ sq. cms.				
Inches	Card	1st Drg.	2nd Drg.	3rd Drg.	Rove	Card	1st Drg.	2nd Drg.	3rd Drg.	Rove	Card	1st Drg.	2nd Drg.	3rd Drg.	Rove
1	14·4	9·4	9·4	8·9	9·2	55·5	45·1	43·1	44·6	43·6	1·15	1·17	1·23	1·23	1·17
3	28·5	22·4	20·9	22·1	24·8	24·9	27·3	26·9	24·6	28·4	1·69	1·56	1·45	1·85	1·62
5	27·1	28·0	27·4	27·3	28·5	12·9	15·6	16·6	15·8	16·2	1·86	2·02	1·84	2·14	1·96
7	16·6	20·4	22·5	22·2	20·3	4·4	7·3	8·4	10·0	7·4	2·41	2·25	2·14	1·96	2·17
9	8·5	11·6	12·5	12·5	11·5	1·6	3·1	3·4	3·6	3·2	2·67	2·32	2·36	2·37	2·20
11	3·4	5·3	5·3	5·0	4·5	0·5	1·1	1·3	1·2	0·9	2·52	2·33	2·12	2·40	2·48
13	1·1	1·6	1·4	1·5	0·9	0·2	0·3	0·3	0·3	0·2	2·22	2·50	2·27	2·36	2·26
15	0·4	0·6	0·4	0·2	0·2	0·04	0·1	0·05	0·03	0·03	2·74	2·61	3·01	2·50	2·35
17	0·05	0·2	0·04	0·03	—	—	0·02	0·01	—	—	1·86	3·01	2·01	3·40	—
	—	—	—	0·01	—	—	—	—	—	—	—	—	—	1·80	—
Weight mean length inches	4·9	5·6	5·6	5·6	5·4	—	—	—	—	—	—	—	—	—	—
Average cross section $\times 10^5$ sq. cms.	1·46	1·55	1·52	1·65	1·55	—	—	—	—	—	—	—	—	—	—

Table II.

Tows and Combed Tows of various sorts and grades.

Sliver leaving	Weight Mean Length in inches						Average Cross Section $\times 10^5$ sq. cms.						Mean Group Cross Section of 1 inch Fibre $\times 10^5$ sq. cms.					
	Tow			Combed Tow			Tow			Combed Tow			Tow			Combed Tow		
	Irish and Courtrai 40's	Irish 20's	Courtrai 45's	Irish Rescutched 20's	Courtrai Rescutched 25's	Courtrai Hackle Tow 40's	Irish and Courtrai 40's	Irish 20's	Courtrai 45's	Irish Rescutched 20's	Courtrai Rescutched 25's	Courtrai Hackle Tow 40's	Irish and Courtrai 40's	Irish 20's	Courtrai 45's	Irish Rescutched 20's	Courtrai Rescutched 25's	Courtrai Hackle Tow 40's
Card	4·9	4·8	4·9	3·8	3·5	4·3	1·46	1·75	1·14	—	—	—	1·15	1·48	0·88	—	—	—
Doubler	—	—	—	4·4	4·0	3·9	—	—	—	—	—	—	—	—	—	—	—	—
Comb	—	—	—	5·0	4·8	5·6	—	—	—	2·44 (5·0)*	—	1·14 (5·0)*	—	—	—	2·20	—	0·74
First drawing ...	5·6	5·5	5·0	5·1	4·8	5·6	1·55	1·78	1·31	—	—	—	1·17	1·46	0·96	—	—	—
Second drawing ...	5·6	5·4	5·1	4·7	4·9	5·8	1·52	1·62	1·16	—	—	—	1·23	1·31	0·81	—	—	—
Third drawing ...	5·6	5·7	5·0	4·7	4·8	5·4	1·65	1·89	1·14	—	—	—	1·23	1·70	0·86	—	—	—
Rove	5·4	5·5	4·8	4·5	4·7	5·2	1·55	1·79	1·10	—	1·72 (4·4)*	—	1·17	1·43	0·94	—	1·5	—

* These average cross section measurements were made on different samples from those used for the determination of weight mean length recorded in columns 4, 5, and 6, so the actual weight mean lengths in these samples are given in brackets below.

This diagram, therefore, shows the entire results obtained for cross section and length, for all these different kinds and grades of flaxes, both line and tow. It has already been pointed out that in this diagram the Irish and Russian line flaxes form a group distinct from the Courtrai flaxes. So now it will be seen that the tows probably form distinct groups for Irish and Courtrai, each being about equally displaced in relation to its line flax group. Rescutched tows are again still further displaced in relation to the tows of each class, and the movements are consistent since Courtrai tow falls into the Irish line group, and Courtrai rescutched tow falls into the Irish tow group of approximately the same lea. This may be expressed by saying that the relative differences in fibre dimensions found between Irish and Courtrai fibre, more particularly cross section, persist whatever the type of fibre being considered, whether line, machine tow, or rescutched tow.

The addition of these tow results to this diagram now confirm and show in a very striking manner the conclusion derived at the end of the discussion on the line results, that the average cross section of the fibre strands was probably a more important characteristic in connection with spinning quality of the fibre than the mean length of the fibre. In line fibres there was found a tendency for the length to be shorter in the finer sorts, accompanied by a decrease in average cross section. Now, however, in the tows we have fibres much shorter than the fibre in the finest sort of Courtrai, but the average cross section is much greater. These facts, together with the fact that it is the average cross section at any length (or the limiting mean cross section of the 1-inch group), and not the mean fibre length, which is in the order of yarn lea in each class group, appear to show very definitely that cross section of fibre strand is most intimately connected with the spinning quality.

SUMMARY OF CONCLUSIONS FROM TOW RESULTS

(1) The machine tow fibres are both shorter and much coarser than the fibres in the corresponding kind of line, and rescutched tow fibres are again still shorter and coarser than the fibres in the corresponding kind of tow.

(2) The behaviour over a tow system is of an entirely different character from that over a line system. An apparent increase in mean length is shown on passing over the first drawing frame, shown to be due to straightening out of long fibres which were doubled or curled up on leaving the card. In combed tows an apparent increase in mean length is again shown on combing, this being due to removal of short fibre in the noils. After leaving the first drawing frame, no further change of any appreciable amount takes place in the length or cross section of the fibres of any sort of flax tow.

(3) Both in machine tow and in rescutched tows, the great difference found in average cross section between Irish and Courtrai line flax was found to persist.

(4) The results confirm those of the line systems in regard to the probability of cross section being a more important characteristic than mean length as regards spinning quality, since in the cases examined, the cross sections have been found to be in the same order as the mill sorting.

(5) These conclusions would indicate that in order to derive the maximum amount of information from tests on this sorting machine, determinations of cross sectional areas are very essential in addition to the length distributions and average length. Also that such measurements should be made at more than one stage of the preparing when comparing the behaviour of different flaxes.

Table III.

Tows and Combed Tows of various sorts and grades

Mean Group Length	Per cent. by Weight in Roves					
	Tow			Combed Tow		
	Irish and Courtrai	Irish	Courtrai	Irish Rescutched	Courtrai Rescutched	Courtrai Hackle Tow
Inches	40's	20's	45's	20's	25's	40's
1	9·2	10·6	13·7	11·9	8·7	7·4
3	24·8	24·2	27·7	36·8	34·9	29·4
5	28·5	25·8	28·1	27·3	31·5	29·7
7	20·3	19·1	17·4	14·7	16·2	19·7
9	11·5	11·8	9·1	6·5	6·2	8·7
11	4·5	5·4	3·2	1·9	2·0	3·5
13	0·9	2·1	0·4	0·7	0·4	1·1
15	0·2	0·7	0·3	0·1	0·1	0·2
17	—	0·2	—	0·1	—	0·03

PART II.

In the previous section particulars were determined of the changes in fibre dimensions and of the relative amounts of the fibres of different sizes as the preparing proceeded. In tow systems it was shown that there was no breakdown, the preparing merely straightening the fibres and gradually reducing the weight of the sliver. In line systems, however, considerable changes in dimensions and weight distribution of the various sized fibres occurred, and these were examined in detail under normal preparing conditions; as a result of the study of the changes which occurred with different sorts of fibre, some conclusions were drawn as to the way in which the breakdown took place. For example, the comparison of Cut line with Long line indicated that in the latter case the ends of the fibre strands were weak and were easily pulled or broken off into lengths of 1 inch mean group length (that is less than two inches in length), which was mainly effected by the spreadboard and the doubler. In later stages the breakdown was accompanied by the formation of fibre of 1, 3, and 5 inches in length in varying proportions, and this process was continued with the same result for many more than the normal number of drawings. Consideration of the change in cross section of individual groups, showed that (except for the shortest lengths), each drawing was accompanied by a decrease in cross section; this appeared to show that the short lengths must be produced mainly by a peeling off from the sides of long fibres, since the short length fibres are of fine cross section. Evidence was also found that in some kinds of fibre, such as Irish or Russian, short lengths were produced in the later stages of the system by being broken off from the ends of long coarse fibres.

In this section some experiments are described which were made with the object of investigating the method in which the breakdown occurs, from an entirely different point of view. In these experiments, the same flax was used throughout (50's Courtrai Long line) and the effect of alterations of working conditions on the dimensions of the fibres were studied. Only the weight mean lengths of the fibres in the samples were determined as a measure

of the breakdown effect. Various changes in working conditions were made, generally using the extreme changes provided for by the machine manufacturers, and care was taken to have only one variant at a time, so far as possible.

As was shown in a previous paper,* dealing with the accuracy of repetition on this sorting machine, with line flax a difference of at least 0·2 inch in the weight mean lengths of different samples is necessary in order to show any significant difference in average fibre length.

FIRST SERIES OF EXPERIMENTS

Altering Weight of Sliver Entering the Frame

Slivers were taken from the second drawing with 4, 6, and 8 doublings, and each was drafted in turn over the same row of pins on the third drawing frame.

Sliver from 2nd Drawing doubled	Weight Mean Length after drafting on 3rd Drawing
4 times	9·36 inches
6 times	9·26 ,,
8 times	9·21 ,,

Assuming that the average length of fibre was the same in the three slivers from the second drawing, no really significant difference in length was shown after drafting, due to alteration of the weight of the sliver drafted.

Packing of the Fibres in the Pins

On a fourth drawing frame, as the fallers rose at the back and penetrated the sliver, the fibre was pressed down by hand, hard against the top of the gill stock. In this way the fibres were packed very much closer together, in this case only occupying less than one-half of their former space. A sample of sliver drafted under these conditions was tested.

On 4th Drawing Frame	Weight Mean Length after Drafting
Normal conditions	8·1 inches
Fibres pressed down in gills	8·0 ,,

Therefore no significant change in the amount of breakdown occurred, due to closer packing of the fibres in the gills.

Effect of Pressure on the Pressing Rollers

To see whether the pressure applied to the pressing rollers had any effect on the amount of breakdown produced by the following drawing frame, the pressure on the front pressing rollers of the second drawing frame was altered to the widest possible extremes and then these slivers were drafted in turn over the same row of pins on the third drawing.

Sliver leaving 2nd Drawing under Pressure	Weight Mean Length after drafting on 3rd Drawing
150 pounds	8·86 inches
450 ,, ...	8·88 ,,

Therefore the pressure on the front pressing rollers may be varied between these limits, without showing any effect on the breakdown in the next drawing.

Effect of Amount of Draft

The effect of draft was tested on several frames, and several varieties of flax, and the results are shown in Table IV.

* *Loc. cit.*

Table IV.

Flax	Frame	Draft	Weight Mean Length after Drafting
45's Courtrai	Doubler	12	11·55 inches
,,	,,	25	11·55 ,,
120's Courtrai	,,	12	9·89 ,,
,,	,,	25	9·99 ,,
30's Irish	,,	12	11·4 ,,
,,	,,	25	11·6 ,,
50's Courtrai	2nd drawing	10	10·2 ,,
,,	,,	14	10·0 ,,
,,	3rd drawing	10	9·18 ,,
,,	,,	14	9·0 ,,
,,	4th drawing	10	8·28 ,,
,,	,,	14	8·18 ,,

From these results the amount of draft does not appear to have any significant effect on the amount of breakdown.

Effect of Speed of the Frame

The third drawing frame was run in the usual way, but very slowly, with the following result—

Sliver leaving 3rd Drawing	Weight Mean Length after Drafting
At normal speed	9·18 inches
Speed as slow as possible	9·22 ,,

The amount of breakdown, therefore, was not affected by the speed at which the drawing frame was run.

ADDITIONAL EXPERIMENTS

It is evident from the results given above that great differences in running conditions may be made without affecting the breakdown of the fibre. The above changes cover all the usual provisions for varying the working conditions, but no evidence was found as to the factors contributing to the breakdown. Other factors which might be considered as having some possible effect are the length of the reach, the length of the nip, the pitch of the pins in the gills, and the pitch of the faller screw as affecting the total number of pins in the sliver. These factors are not variable on the machines, but some data on their effects was obtained in an indirect way.

Drafting of the same Fibre on Different Frames

A sliver from the second drawing frame, in which the weight mean length of fibre was 10·0 inches, was taken and drafted on the doubler, the second, third, and the fourth drawing frames, in each case the requisite number of doublings being made to make the weight of sliver entering the frame as nearly as possible the same as usual for the particular frame. In this case, of course, many variants are involved; some of these, such as draft and speed, have already been shown to be without effect, but others such as reach and pitch of pins were unknown factors. The results obtained were as follows—

Normal 2nd drawing sliver (mean length 10·0 inches)

Drafted on Frame	Reach inches	Pitch of Pins per inch	Weight Mean Length after Drafting
Doubler	26	16	9·1 inches
Second drawing	22	28	9·23 ,,
Third drawing	20	32	9·18 ,,
Fourth drawing	18	36	9·38 ,,

The amount of breakdown, therefore, was very much the same on all these frames, in spite of the differences in reach and pitch of pins. The longest fibre in the original second drawing sliver was 25 inches, so that on

the doubler there was no question of breakdown being brought about by fibres being longer than the reach, and the pins were fairly wide spaced, yet the same breakdown was obtained as on the third drawing frame, for example, where the reach was 5 inches shorter than the longest fibre in the sliver being drafted, and the pitch of the pins was just twice as fine as that on the doubler. The same result was again obtained on putting this sliver from the second drawing straight on to the fourth drawing frame.

From these results it would appear that neither the reach not the exact pitch of pins is very important in determining the amount of breakdown.

Location of Point of Breakdown

In all flax drawing frames, the fallers have a small positive lead on the fibre, the relative velocities of fibre and faller remaining the same until the fibre is gripped by the front pressing rollers. It is conceivable, that if the back pressing rollers were very efficient and if the pins should become very firmly engaged with the fibre, that this lead of the fallers on the fibre might be sufficient to produce breakage of the fibre at the back of the frame; this was not considered very likely, as a small percentage of fibre of length greater than the reach is usually found in any sliver, which indicates that slipping occurs at the back rollers. In order to establish definitely whether the breakdown occurs at the back or the front of the drawing frames, the following experiment was made.

A sample was run through with the front pressing roller removed, so that there was no drafting and the only action on the sliver was that of the faller lead. The following result was obtained—

	Weight Mean Length
Normal entering 3rd drawing	10·0 inches
Leaving 3rd drawing, no draft	10·08 ,,

Hence there is no breakdown effect shown due to the faller lead, and so it appears that the breakdown actually occurs at the front of the drawing frame during the drafting, and yet, as shown above, alteration of the amount of draft over a wide range did not alter the amount of the breakdown, nor was it affected by the speed of the frame, which alters the relative speed of the fibre and the gills in the same way as altering the draft. From these results it began to appear that as the breakdown was brought about by any drafting, under widely different conditions of support, it must be dependent on some condition of the fibre, either natural or artifically produced. In the latter case there are two possibilities, either the fibre may be left in some particular condition on leaving the preceding drawing frame, or some particular condition may be produced on the fibre by an action of the pins when penetrating the sliver. This was tested directly.

Effect of Pin Penetration at Back of Drawing Frame

(1) A sliver from the second drawing frame was put over the third drawing without draft, as described above, and then carried on to the fourth drawing and drafted in the usual way. This sliver then was twice pinned at the back of the frames by fallers before drafting, so if compared with a normal sliver drafted on the third drawing, any difference would be due to this extra pinning. The following results were obtained—

	Weight Mean Length
Sliver leaving 2nd drawing	10·0 inches
Pinned only, 3rd drawing; no draft	10·08 ,,
Do. do. then drafted on 4th drawing	8·8 ,,
Normal leaving 3rd drawing	9·18 ,,
Do. do. after 4th drawing	8·1 ,,

Hence twice pinning of the sliver before drafting causes a greater breakdown on drafting than the usual single pinning (from 9·18 to 8·8), but not so great as when twice pinned and twice drafted, and so it would appear that both pinning at the back of the frame and the drafting on the previous frame each have some effect in creating the condition of the fibre necessary to bring about the breakdown.

(2) The effect of pin penetration at the back of the frame was also tested in another way. The number of fallers engaged was altered by removing every other faller in one case and by removing two out of every three fallers in another case, which reduced the number of times the sliver was pinned. The following results were obtained—

Sliver drafted	Fallers	Weight Mean Length after Drafting
On 3rd drawing	Normal	9·18 inches
	Every other one removed ...	9·47 ,,
On 4th drawing	Normal	8·1 ,,
	Every other one removed ...	8·39 ,,
	Two out of every three removed	8·53 ,,

The results show rather definitely that reduction in the number of times the sliver is penetrated by the fallers causes a reduction in the breakdown on drafting, and therefore confirms the results of (1), where the breakdown was increased by extra pinning before drafting.

From the experiments so far carried out, therefore, we may conclude that breakdown occurs at the front of the drawing frame under the action of drafting, whatever the amount, but the fibre is prepared for this breakdown by being left in some necessary condition—

(1) By the effect of the previous drafting.

(2) By the effect of penetration of the sliver by the pins at the back of the frame. This is presuming that the same material is used, and it is probable that there may be conditions depending on the natural state of the fibre.

Visual Examination of Action of Pins

The slivers in a head were carefully cut, leaving a length of about 4 inches remaining in the gills. This block of fallers was then carefully lifted out of the machine for examination. On viewing the fibre through a magnifying glass, numerous cases were observed in which pins were situated between the main fibre strand and a branch with a free end, but no case of direct penetration of the pins into a fibre strand or a ribbon of strands was seen. A number of fibres were gripped at the ends between the fingers and slowly drawn forward through the gills, as might be the case in drafting; in very few cases was any decided resistance encountered. Quite a large proportion of these fibres after extraction appeared to be much longer than the length of the sliver from which they had been pulled. Examination of these particular fibres showed that they consisted of a coarse main stem and a finer branch, held together over a short length with the branch folded back along the stem, so that the two free ends, which originally had been at the same side of the junction, were now on opposite sides. Apparently these fibres are produced as a result of a pin entering between the stem and the branch, and on pulling the stem forward, the branch is held against the pin by the other fibres for some time, after which the branch follows through with the stem, so that on extraction the branch is bent back on itself, possibly with the join with the stem reduced in length.

In the usual preparing process this fibre is presented to the next frame in the reverse direction; hence if the end of the branch protrudes beyond the end of the stem, it would be gripped first, and the restraint imposed on the stem by the surrounding fibres and the pins would probably give sufficient resistance to permit of the branch being pulled clear under the action of the drafting. If the end of the branch is not protruding beyond the end of the stem, but is fairly close to it, cases may arise in which a pin penetrates a fork between stem and branch, and then the two ends become gripped by the front drawing rollers almost simultaneously; here the branch would get torn away from the stem or it would break at the pin, according to the relative strengths of the fibre and the join. A third case occurs when the end of the turned back branch is not near the end of the stem; here the most likely effect is for the branch to get turned back again into its original direction, and this might occur whether penetration of the fork by a pin happens or no.

It must be borne in mind that the entanglement of the fibres, due to short branches not lying close to the stem but sticking out at all angles, would also act in much the same way as pin penetration between a branch and its stem. It may be that some such effect is accountable for the extra breakdown which was shown to be produced by drafting irrespective of pin penetration. Probably these remarks apply with most force to branches of some length; in a sliver all kinds of conditions exist simultaneously, and no doubt other branches, such as very short or stiff branches, pass through without reversal of direction unless directly pinned. This view of the manner in which the breakdown is effected, seems to imply that the main effect of the pinning and the drafting is a reversal of direction of certain side branches, which apparently is the artificial condition of the fibres in the sliver referred to above. This, therefore, appears to place some importance on the direction in which the branches point, the condition advantageous to breakdown being that in which the branch points in the direction of motion of the sliver through the frame, as this presents the fork in the right way for the pin to become operative in the manner explained. It therefore follows that the reversal of direction of the slivers in consecutive drawings, would also appear to be of importance. This reversal of the slivers between each drawing is the normal procedure, possibly because it is the most straightforward way of dealing with slivers in cans. This point appeared to be of considerable interest, particularly as it is possible to test by direct experiment, and so obtain confirmation or otherwise of the opinions described above.

Effect of Direction of Sliver

Two lots of samples were prepared from 50's Courtrai Long line. The fibre was spread in the ordinary way and carried on to the second drawing, samples of the slivers being taken from each stage. In the one case the normal procedure was adopted, the slivers being reversed between each drawing, so that the directions of the fibres were also reversed every drawing. In the other case, the slivers were always kept the same way by inverting the cans at the back of the frames, so that in this case the fibres were always kept in the same direction. The usual measurements of weight mean length and average cross section were made on each sample, and the results are shown in Table V.

It will be seen that when the fibre direction is reversed at every drawing, the amount of breakdown in length is definitely greater than when the fibre is always kept in the same direction, and a similar effect on the cross section

Table V.

Sliver leaving	Direction of Fibre in Drawings			
	Reversed (normal)		Constant	
	Weight Mean Length inches	Average Cross Section $\times 10^5$ sq. cms.	Weight Mean Length inches	Average Cross Section $\times 10^5$ sq. cms.
Spreadboard	14·3	1·77	14·3	1·77
Doubler	11·95	1·45	12·7	1·45
First Drawing ...	11·42	1·33	12·25	1·37
Second drawing ...	10·2	1·26	11·20	1·28

is indicated. The results, therefore, appear to give a direct experimental confirmation of the validity of the views expressed as to the manner in which the breakdown occurs.

Further, it may be noted, that even when the fibre direction is kept constant, a considerable amount of breakdown occurs. On the hackling machine both ends of the fibre are combed from the centre, so that when put on the spreadboard there are probably branches pointing in all directions. According to the opinion already expressed, when the fibre direction is kept constant, after a certain number of drawings these branches should all become turned in one direction, and then reversal of direction should cease, together with breakdown from this source. Probably a number of drawings are required to bring about such a condition, and if it is attained, breakdown would presumably still occur as a result of branches being held back by entanglement with the other fibres and the pins. The smaller amount of breakdown obtained when the fibre direction remains constant, after a number of drawings, possibly represents the same effect as was noted earlier, namely, the amount of breakdown due to drafting in excess of the pinning effect at the back of the frame (pages T430 and T431).

SUMMARY OF CONCLUSIONS

From the results given, it appears that, at least for Courtrai Long line, the following conclusions may be drawn—

(1) Such factors as the amount of draft, weight of sliver, pressure on the front pressing rollers, speed of frame and tightness of packing in the pins, do not have any decided effect on the amount of breakdown of the fibre passing over the drawing frames.

(2) The breakdown takes place at the front of the drawing frame.

(3) The same sliver may be drafted on such different frames as a doubler and other frames up to the fourth drawing, and the same breakdown obtained, in spite of the great differences in reach and pitch of pins.

(4) The breakdown is connected with the number of times the sliver is penetrated by the gills, and the drafting leaves the sliver in some condition which assists the breakdown on the following frame.

(5) Results of visual examination offer an explanation of (4). It was seen that pins penetrate between branches and their stems, and when pulled forward, these branches, if pointing in the right direction, are bent back on the stem and may also be partially pulled off. On presenting this fibre in the reverse direction to the next drawing frame, this branch may be gripped

before the stem, when it would act like a weak end and be pulled off; if the branch is pinned at the fork but the stem becomes gripped first, it would probably be reversed in direction and so stand the best chance of being pinned again in the same way when again the fibre is reversed on the next drawing.

(6) The above view places importance on the action of reversal of direction of the sliver at each drawing, as being an aid to the breakdown of the fibre. This was confirmed by a direct experiment, in which it was found that if the fibre direction is kept constant in successive drawings, less breakdown is obtained than when the slivers are reversed in direction in successive drawings.

(7) It is concluded from the experiments in this section, that the breakdown of flax fibre strands which occurs on drawing frames, is partly the result of a combined action of the penetration of the sliver by the pins and of the drafting, the two effects together forming an arrangement for peeling off side branches from the main fibre stand. The actual breakdown may not take place after the first pinning, since one or more draftings (according to the position of the branch on the stem) may be necessary to prepare the branch, to put it in such a condition that it may be easily stripped off. Entanglement of the branches with the other fibres and the pins also appears to aid in the breakdown, acting in the same way as the pins which penetrate into a fork between a stem and a branch, and this effect is thought to be operative whether or no the fibre is reversed between successive drawings. The amount of breakdown would then be expected to depend very much on the character of the fibre strands, particularly on its capacity for branching.

(8) The results substantially confirm the conclusions arrived at in the first part of this paper, as to the nature of the method of breakdown of flax fibre strands on the usual preparing machinery. The reduced rate of breakdown of cross section there found would then appear as a natural consequence of the peeling arrangement, as a continually decreasing number of branches would be present. In the same way, the absence of breakdown with tow fibre would appear to be due to the absence of side branches of suitable type, which are presumably stripped or broken off in the card.

Received for publication, 16th April 1926

* *NOTE*—Author's note supplied subsequently—In this case the lines are only put in to show the positions of the 1 inch group corresponding to the group of points representing the measurements on each system. It is not intended to imply, as was the case with line fibre, that extra drawings would bring about changes represented by points on these lines, since we have no evidence of any breakdown occuring with tow fibres.

39—THE LEVELNESS OF MULE YARNS

By S. G. Barker, Ph.D., D.I.C.
(The British Research Association for the Woollen and Worsted Industries)

In a note of criticism of my paper on the "Gravimetric Method for Investigation of the Variation of Levelness of Yarn," A. E. Oxley makes certain statements which call for serious comment.

In wool, twist and count on short lengths are closely, though perhaps not absolutely connected. The nature of wool tends to allow the twist to distribute itself more in the thin places and less in the thick ones. Faults due to uneven twist on short lengths, when counts are constant, exist, but are comparatively rare. It is therefore seen that in the case of wool, places of maximum weight or count are usually places of minimum twist, and *vice versa*. Work is now proceeding on the exact determination of this relationship. The gravimetric test has recently been employed for the investigation of the variation of thickness of woollen yarns in woven fabrics. The work is almost complete, and will be published shortly. Up to date they show that at places where an apparently thick piece of yarn shows up prominently this portion of yarn is of higher count and conversely. The detailed examination of twist at these points is also proceeding. I wish, however, to emphasise—

(1) That the gravimetric method does detect these variations of thickness due to variations of quantity of material in woollen yarns.

(2) There is some connection between count and twist in short lengths of woollen yarns. Thin places taking up greater twist and *vice versa*. Hence, since thin places would weigh less, the gravimetric method is applicable.

(3) Any method employing compression is unsuitable for woollen yarns, as, e.g., that due to Oxley.

(4) I did not attribute the periodicity to any definite cause without further investigation. My reference to Williams' work, which considered twist, shows that I did not overlook twist as a possible explanation. To quote from the paper regarding thick and thin places, I say—"They may be due to various causes . . . . Variations may also be due to irregular action of the mule itself or to variations of the condenser, but mere surmise on this point is unwise without further investigation."

This statement clearly shows that I refused to attribute the phenomenon to any cause whatever without further investigation. I mention Williams' work as a possible line of action. Oxley's statement that I apparently consider "that levelness of yarns can be satisfactorily interpreted in bulk of cotton, ignoring completely variations of twist," is absolutely incorrect. I do not consider that levelness of yarns can be satisfactorily interpreted in "bulk of cotton" or otherwise, since I have no justification for such an assumption, having done no work in this direction on cotton, neither do I make such a statement. On the contrary, I state in discussing the method due to Oxley that in the case of woollen yarns "the true variations would be even more difficult to determine by this method than in the case of cotton,

since count, twist, and the volume or bulk compressibility would have to be allowed for in such observations." These are serious objections, in my opinion, but the statement proves that I was alive to the existence of the influence of twist as well as count. In conclusion I would point out that in an earlier paper with King, I have duly acknowledged the form of the micro-balance &c. to Dr. Balls, F.R.S., but I do claim that this is the first time its use has been applied to woollen yarns. I accept Oxley's correction *re* "shoe and plate." Finally, in the case of wool, our experiments conclusively show

(*a*) Thick places occur at distances apart equal to the mule draw, and these can be detected by the gravimetric method.
(*b*) Faults due to portions of thick and thin yarns in woven fabrics can be analysed by the gravimetric method.
(*c*) Variations of twist have also to be considered, but in view of the facts above mentioned may be closely related to count variations.
(*d*) Two subsequent papers are almost complete and will show that gravimetric analysis of the yarn has much to reveal in connection with faults in wool fabrics.

* I wish, however, to record that in connection with Oxley's criticisms of my paper, I was not afforded the usual courtesy of allowing an author's reply to accompany and be published immediately after the criticisms.

"Torridon,"
Headingley, Leeds,

5th August 1926.

* The Editor regrets that a desire to secure the speedy publication of a communication which only just arrived in time for insertion in the July issue, made it impossible to publish a reply from Dr. Barker at the same time.

40—THE BEHAVIOUR OF FLAX YARNS UNDER REPEATED IMPACTS

By G. F. New and A. L. Gregson

(The Linen Industry Research Association)

During the process of weaving, the warp yarn is subjected to the action of a complex system of destructive forces. The only satisfactory method of investigating these forces and their effects on the yarn is to separate them and to study each in turn, in an instrument specially designed to reproduce the action in a controllable manner. A considerable amount of useful information concerning the influence of various characteristics of the yarn and of various external factors on the behaviour of the yarn can, in this way, be acquired. In following out such a course the destructive effects of friction which are met with in the loom have been isolated in a form suitable for detailed examination in the Wear testing machine for yarns recently described.* In order to study the tensile stresses produced by the strains operating on the yarn in the loom, a recording stress-strain testing instrument† was developed. With the apparatus used for that work, however, it was impossible on account of inertia effects to apply loads or remove them at a rate comparable with that occurring in the loom and obtain at the same time accurate records. Further, it was extremely inconvenient to apply a long succession of similar stress cycles to the specimens of yarn. The present work was undertaken in order to acquire knowledge as to the effects on yarn structure and yarn properties of the many repetitions of a rapidly applied stress, corresponding to conditions imposed during weaving. Before proceeding to a description of the apparatus employed it is advisable to consider what are the stresses actually met with in the loom.

The Character of the Stresses in the Warp Yarn during Weaving

The rate at which the load on the warp yarn increases depends on the design and setting of the loom and on the elastic properties of the yarn. Among the loom factors involved in determining the rate of loading due to the shedding motion are: the rate at which the loom is being driven; the depth of shed; the shape of the wyper or cam operating the heddles; the distance of the fell of the cloth and of the taking-up roller from the lease rods and from the yarn beam, and the height of the front and back rails above the centre of the shed. With the beating-up motion, the loom factors operating include: the velocity of the reed and the way in which this velocity varies and, in so far as the resistance to the passage of the weft is affected, all those factors on which depend the position and tension of the warp due to the shedding motion.

With a loom speed of 160 picks per minute, which is typical for a plain loom 36 inch wide, $\frac{1}{8}$ of a second might be allowed for the dwell of the shedding motion and $\frac{1}{4}$ of a second for the change, during which period the warp passes through its slackest position. Thus the mean time taken for the tension to reach its maximum is approximately $\frac{1}{8}$ of a second. The time taken to reach the maximum tension, due to the beating-up will depend on the loom setting, but most of the forces will be applied in a period that will seldom exceed $\frac{1}{30}$ of a second. It is evident, therefore, that any experimental

* G. F. New, L.I.R.A. Memoir No. 10, *J. Text. Inst.*, 1924, **15**, T230.

† G. F. New, L.I.R.A. Memoir No. 1, *J. Text. Inst.* 1922, **13**, T25.

apparatus designed to reproduce this feature of the weaving process should be capable of applying a load to the yarn within a time period of this order or less.

The maximum tension and also the rate of application of the tension in each individual warp thread in the loom are influenced by the mean extensibility of the stressed portion of that particular thread and by the changes

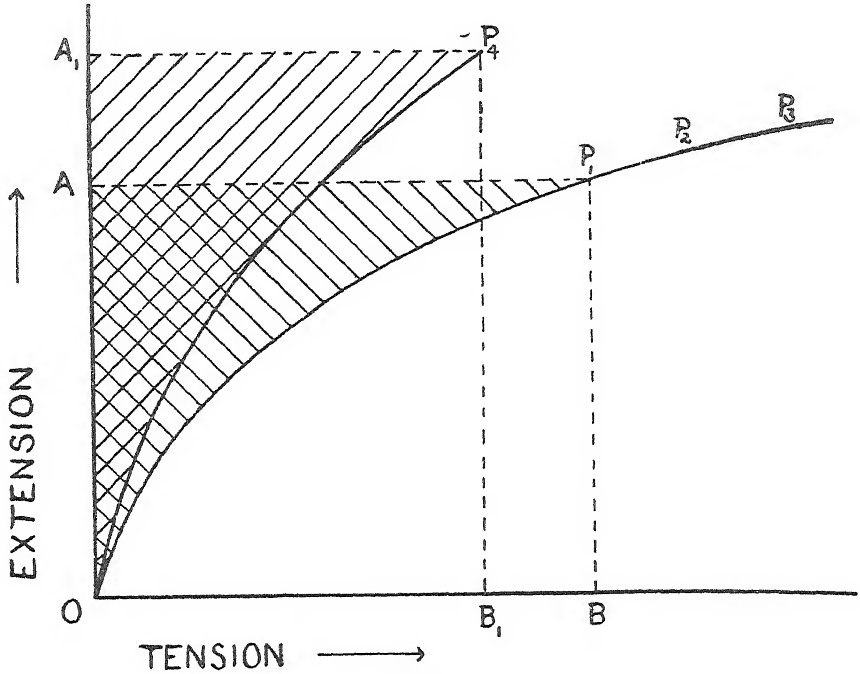

FIG. 1

Typical tension/extension curves for flax yarns, showing the effect of equa impacts on yarns of different extensibility.

in extensibility with increasing load. Thus, since practically the same extension is demanded from each thread in plain weaving, a very extensible thread will bear a smaller share of the total force than its less extensible neighbours. The elastic properties, and their regularity as well as the breaking tension are therefore of fundamental importance in determining the loom behaviour of a yarn. For good weaving it is generally assumed that the extensibility of warp yarns should be as great as possible. It must be remembered, however, that the total extension at breakage consists partly of elastic or recoverable extension and partly of non-elastic, irrecoverable, or permanent extension, and that the extension recorded on the breaking strength testing machine gives no indication whatever as to the relative proportions of these two components. A large permanent extensibility may be an undesirable feature in warp yarns. A strain on such a yarn causes an increase in its irregularity since the thin places, which have more than normal twist, extend more than the thick places, which have less than normal. The repeated strains imposed on such a yarn during weaving will therefore render it progressively more vulnerable. On the other hand, a yarn of similar extensibility, but possessing a higher proportion of recoverable extension, will

undergo much less permanent change in configuration as a result of the repeated strains and will therefore be less likely to break.

Features to be Reproduced in Experimental Procedure

The forces acting in a loom vary in such an irregular manner that they cannot be reproduced exactly by a simple piece of apparatus, even if such exact reproduction be desirable. Simplicity in the experimental apparatus is valuable in that it favours the correct interpretation of results. After careful consideration it was concluded that the imitation, in a controllable manner, of the rapid stressing which the warp undergoes during weaving could best be effected by applying an impact by means of a falling weight, and the apparatus used is based upon this principle. The falling weight is attached to the lower end of the yarn specimen, the upper end of which is clamped to a rigid support. By this means both the magnitude of the tension produced in the specimen of yarn and the rapidity of its application can be varied at will by changing either the weight used or the height through which it is dropped or the length of the specimen. The motion of the weight as it is brought to rest resembles damped simple harmonic, and the time occupied in bringing it to rest will approximate to

$$\frac{\pi}{2} \cdot \sqrt{\frac{w}{t \cdot g}} \qquad . \quad . \quad . \quad . \quad . \quad (1)$$

where t is the tension produced by unit extension; w is the weight, and g the acceleration due to gravity; t varies directly with the Young's Modulus for extension of the yarn and inversely with the length l of the specimen. The time of loading, therefore, will vary approximately as $\sqrt{w \cdot l}$ and may be brought to any desired value by adjusting w or l. It is not dependent to any great extent on the height through which the weight is dropped.

The effects on the yarn are best studied with the aid of a tension/extension curve as shown in Fig. 1. The kinetic energy of the moving mass is completely transferred to the yarn, partly as heat and partly as potential energy to be manifested in a subsequent contraction. The behaviour of the yarn during this process is such that the area enclosed between the curve O P_1 P_2 P_3 and the extension axis O A A_1, exactly represents this energy. As the kinetic energy to be absorbed increases, so will the point P_1 move further along the curve, thus indicating increases in both tension and extension produced in the yarn. For a given energy transference, however, it will be seen that a more extensible specimen giving a curve such as OP_4 will, in order to enclose the same area as OP_1A, proceed to a point P_4, corresponding with a smaller tension B_1 but greater extension A_1. With a uniform mass and height of drop, and therefore uniform energy of impact, the specimens which are least extensible will be subjected to the greatest tension, a feature which is exactly comparable to the effect of shedding in the loom on the warp yarn. With a yarn having a straight line tension/extension curve, a condition to which flax yarns approximate after the application and removal of a tensile stress, the energy of extension

$$\begin{aligned} wh &= \tfrac{1}{2}\, T \times \text{extension} \\ &= \tfrac{1}{2}\, T^2 le \qquad . \quad . \quad . \quad . \quad . \quad . \quad (2) \end{aligned}$$

where T is the maximum tension reached, and e is the extension of unit length on the application of unit force.

$$T^2 \text{ therefore varies as } \frac{wh}{l}$$

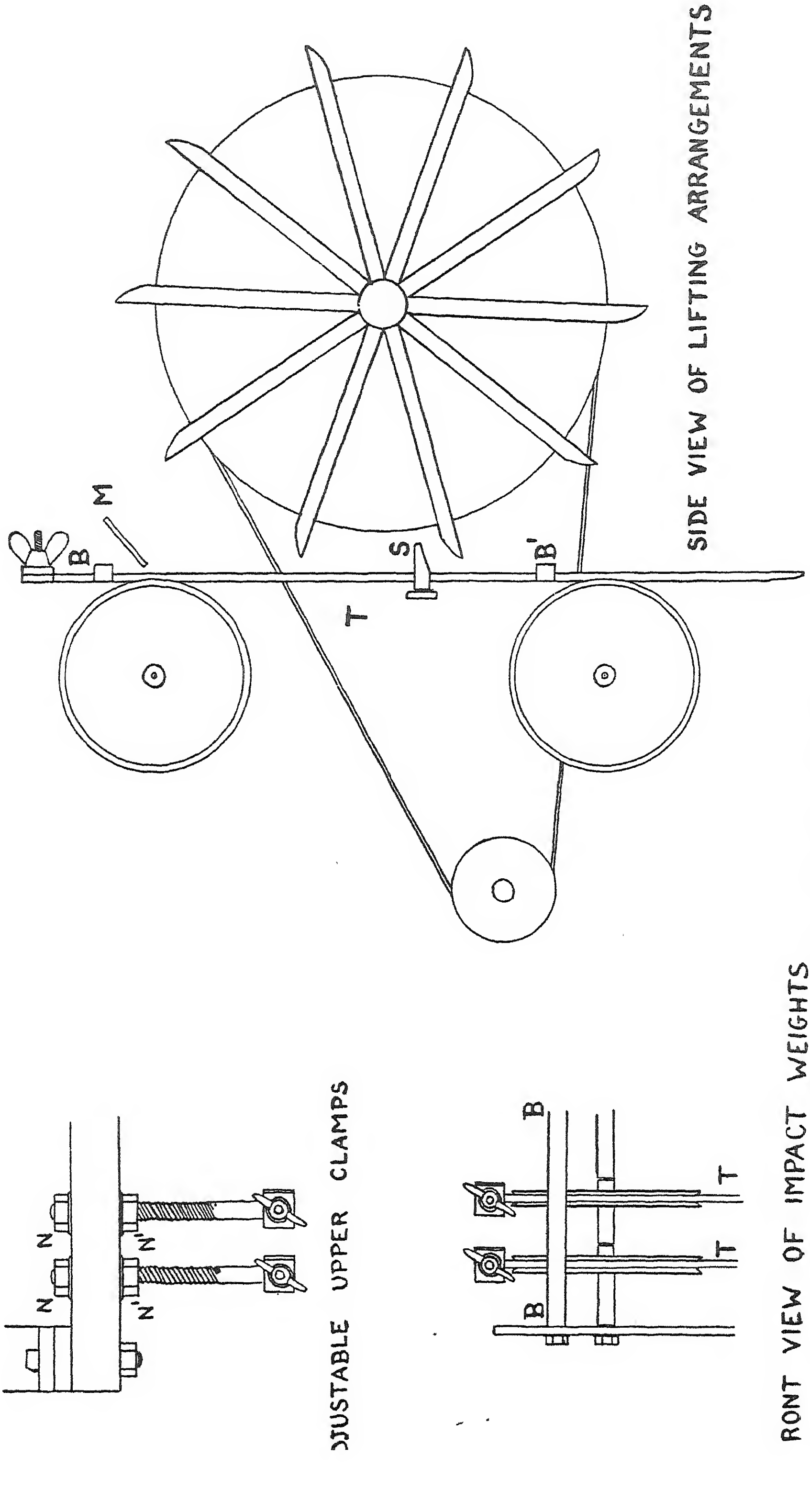

FIG. 2—Diagrams of the Impacting Apparatus.

The Apparatus used

An apparatus for applying impacts in this manner was constructed and is illustrated in the diagram (Fig. 2). The tension pieces consist of 10 rods "T" of square section, 12 inches long with $\frac{1}{8}$ inch sides. Each carries a brass clamp soldered to its top end, and a projecting steel set-piece "S" which can be fixed at any height on the rod by means of small set-screws. The tension pieces slide in grooves cut in the horizontal bars, B, B, and B_1, B_1, which guide the front and sides, while the back is constrained from moving horizontally by 3 inch diameter wheels with V-shaped rims, freely rotatable on shafts which can be adjusted so that the rims just touch the tension pieces. This reduces the dragging and the pushing effects caused by the raising mechanism and the friction opposing downward motion of the tension pieces is minimised. All tension pieces have been adjusted to the same weight, namely, 46·25 grams by filing away excess metal from suitable parts.

A shaft is mounted, with freedom for adjustment, 10 cms. in front of the row of tension pieces. Ten steel arms are set in the shaft in a spiral manner, so that one arm engages each tension piece, each arm being set in at an angle of 36° with the next. One revolution of the shaft then raises each set-piece in turn to a definite height, where the circular path of the end of the arm leaves the vertical path of the tip of the set-piece. The ends of the arms are cambered to reduce the upward velocity of the tension pieces as this point is approached and also to minimise the effects of wear. A driving pulley is keyed to one end of the shaft, and a revolution counter is mounted on the other.

A millimetre scale is etched on the front face of each tension piece at such a distance below the clamp that the zero mark of each scale can be brought opposite the lower edge of the groove in the top guide bar, which was used as a reference mark. The lower end of each yarn specimen is gripped in the clamp on the tension piece and the upper end in a clamp vertically above it at such a height that when the zero mark of the tension piece scale is opposite the reference mark, the length of yarn between the two clamps is 50 cms. A strip of plate glass mirror M, 1 inch wide, is fitted in front of and parallel to the top guide bar with its face inclined at an angle of 50° from the vertical, to facilitate observations. The upper clamps are rigidly attached to the lower ends of threaded rods fitting loosely through holes drilled in a solid steel bar of such dimensions as to reduce bending under the impact forces to a negligible amount. The clamps are adjustable in height and are held in position by the two locking nuts N, N^1 above and below the steel supporting bar.

As will be seen from previous remarks, the energy of the falling tension piece is directly proportional to its weight and to the distance through which it falls, neglecting friction. Throughout the experiments which are described below the only factor which has been varied is the height of drop. This was changed by raising or lowering the steel set pieces on the weights. The length of specimen was kept constant at 50 cms. and the weights remained at 46·25 gms. By substitution in the formulæ (1) and (2), given above, the approximate time of loading and maximum tension can be found. Taking an extension of 1·5 cms. on the application of a load of 1,000 gms. as typical of a 40 lea flax line yarn, the time of loading will be approximately

$$\frac{\pi}{2}\sqrt{\frac{46{\cdot}25}{666{\cdot}7 \times 981}} = 0{\cdot}0082 \text{ second}$$

The maximum tension T induced in the yarn by a fall of the weight through, say, 3 cms., will be approximately

$$\sqrt{\frac{46{\cdot}25 \times 6}{{\cdot}0015}} = 430 \text{ gms. wt.}$$

Experimental Procedure

The usual procedure was to give one impact to each specimen, record the extension, and readjust the height of the upper clamps by means of the locking nuts to bring the zero of the scale back to its initial position. The

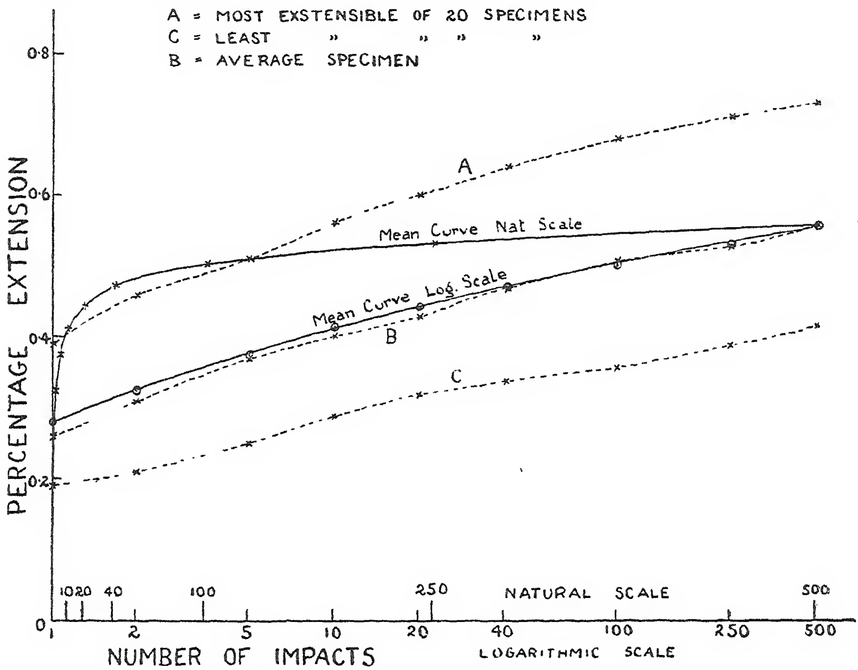

FIG. 3

The irregularity of the extension produced by repeated impacts on a green flax line yarn, 40 lea, No. 68P.

extension recorded as produced by an impact is the difference between the readings of the tension-piece scale when the tension piece is hanging at rest supported by the yarn immediately before and immediately after the impact is given. This is the "permanent" or "residual" extension of the yarn: the extension recorded gives no information concerning the "elastic" or recovered extension. After the first few impacts the extension caused by successive impacts is so small that a considerable number can be applied between successive readjustments of the upper clamp. Readjustments are then made every time the extension increases by 0·3 mm. The speed of the shaft is kept sufficiently low to ensure that the inertia of the tension piece does not carry it upwards after it leaves the lifting arm. It is found that a rate of one impact in three seconds to each specimen is sufficiently slow to prevent this. If a greater number of impacts per minute is required, it may be obtained by increasing the number of arms in the shaft. The number of impacts per minute, however, is limited by the time taken for adjustment

rather than by mechanical considerations. Extension readings have generally been taken after 1, 2, 5, 10, 20, 40, 100, 250, 500, and in some cases 1,000 impacts. For extension experiments, the impacts were generally made sufficiently severe to cause one thread in ten to break before receiving the full treatment; the height necessary for this being found by preliminary trials.

An equal number of yarn specimens was taken at random from every available cut of each sample examined. For comparative tests, specimens for the different treatments were, wherever possible, taken from different parts of the same threads. All tests were made under constant conditions of temperature, 68° F. ±1° F. and humidity 75% ±1%. Further, different parts of each comparison were made in succession.

The Character of the Extension due to Repeated Impacts

In Table I. is given a typical series of extension observations made on a 40 lea green flax yarn using a drop for the weight of 5·25 cms. and in Fig. 3 are shown graphical records obtained with the same yarn using a drop of 3·10 cms. It is important to consider the variation in the extensions shown by different specimens of the same yarn after they have received the same number of impacts. To obtain an accurate estimate of this variation would necessitate the use of a large number of specimens, but a rough indication can be obtained from the comparatively small number of observations available. The mean deviation of individual observations from the mean is generally found to be of the same order of magnitude as that for the breaking tension tests on the same yarn. As an example, 20 specimens of a 40's Courtrai line gave the mean deviation 13·6% for the extension after one impact, a value which is equal to that found for breaking tension tests of similar specimens of the same yarn.

Table I.

Increase in extension for 40's green flax line yarn in mms. Length, 50 cms. Impact height, 5·25 cms.

Specimen No.	1	2	3	4	5	6	7	8	9	10
No. of Impacts										
1	2·10	2·25	2·05	2·20	2·60	2·00	2·15	2·95	2·15	2·15
2	0·25	0·25	0·15	0·60	0·60	0·10	0·65	0·30	0·35	0·60
5	0·40	0·40	0·35	0·40	0·30	0·15	0·30	0·45	0·45	0·50
10	0·10	0·15	0·10	0·20	0·30	0·20	0·25	0·25	0·10	0·20
20	0·25	0·25	0·10	0·30	0·30	0·15	0·40	0·25	0·20	0·35
40	0·20	0·30	0·10	0·10	0·15	0·10	0·25	0·25	0·25	0·35
100	0·15	Broke at the 57th impact	0·10	0·65	Broke at the 90th impact	0·20	0·25	0·10	0·20	0·25
250	0·15		0·05	0·15		0·10	0·10	0·25	0·10	0·40
500	0·10		0·10	0·15		0·15	0·30	0·30	0·30	0·15
Total extension for 500 impacts	3·70	(3·60)	3·10	4·75	(4·25)	3·15	4·65	5·10	4·10	4·95

It was found that the mean extensions of 20 specimens were in regular progression and that if the mean extension for each number of impacts were expressed graphically, the points obtained all fell close to a smooth curve. Twenty specimens were, therefore, usually employed to obtain typical mean extension curves. The mean curve was found to be of the same genera form for flax yarns under all the various conditions examined.

These points are illustrated graphically in Fig. 3. The dotted curves are the extension graphs of three individual yarn specimens chosen to indicate the amount of variation found between different specimens of the same yarn sample. The three curves are obtained from the most extensible (curve A), and the least extensible (curve C) of 20 specimens of a flax line yarn, and (curve B) from one that had the same extension at 500 impacts, as the mean

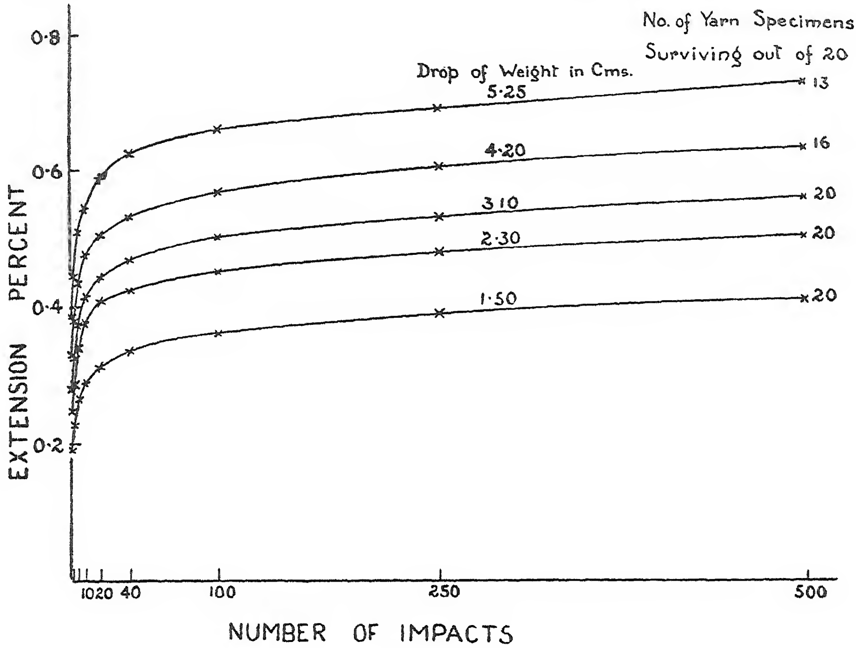

FIG. 4
The influence of the intensity of the impact on the yarn extension. No. 68P.

of the whole 20 specimens. The number of impacts are plotted on a logarithmic scale in order to show more clearly the initial stages of the extension. It is evident from the close approximation of these curves to straight lines that the cumulative extension y is related to x, the number of impacts, in a manner very closely similar to that represented by the equation

$$y=A+B\log x$$

where A and B are constants. The mean curve is also given in a natural scale and illustrates the general form of a mean extension curve for all flax yarns under repeated impacts. The important points brought out by these results, as illustrated graphically by the mean curve are (*a*) the first impact gives rise to an extension of relatively considerable magnitude, (*b*) successive impacts cause progressively smaller increases in the total extension, and (*c*) 500 impacts are insufficient to bring the yarn into a "steady condition." That is, even after the application of 500 impacts, further impacts on the yarn under the same conditions cause further "permanent" extension. The approximation of the extension curve to logarithmic form suggests that a "steady" condition can never be attained, however many impacts are applied.

The explanation put forward to account for the shape of these curves is the same in principle as that given for the extension and the changes in

yarn extensibility with a constant slow loading rate.* This is that a load on a flax yarn produces slipping and straightening with consequent tightening of the fibres until a state is reached where close lateral contact precludes further appreciable tightening, and mutual locking increases frictional forces to such an extent that slipping is almost entirely prevented. The changes in the elastic properties of individual flax fibres when loaded have not yet been studied. The effect on stress-strain curves and on these impact extension curves of varying yarn factors, however, shows that these factors have a much greater influence than the elastic properties of the fibres themselves. The extension due to the first impact is the "residual" or "permanent" extension between 46·25 gms. and a load which may easily exceed 50% of the breaking tension. The permanent extension produced by the impact is probably less than that produced by slow loading between the same loads, especially where there is any plastic deformation of binding material and other inelastic components of the yarn. With the second impact the force induced in the yarn is greater than with the first because the decreased extensibility of the yarn brings the falling weight to rest in a shorter travel. The greater force of the second impact, however, causes considerably less residual extension than the first impact, because it acts on the yarn in the more tightened condition. Additional impacting produces a progressively more tightened state of the yarn with a consequent progressive reduction in the extension produced. The interesting fact that, under the conditions investigated, yarn has never been brought to a state in which further impacting did not produce further "residual" extension is comparable with the conclusions reached from the stress-strain investigations. It was shown that (1) the stress-strain curve never quite attains the elastic straight line relationship, (2) a number of successive loadings and unloadings continue to produce small increases in "residual" or "permanent" extension, the yarn never reaching a cyclic condition.

It will be noticed from Table I. and from some of the curves shown in this paper that the extensions produced in a specimen of yarn by successive impacts do not change in a regular manner. This erratic behaviour has been found in flax yarns under all the conditions examined. The features of the testing instrument such as imperfect clamping or friction on the tension pieces, which might possibly give rise to such effects, have been carefully examined, but the influence of such factors appears much too slight to account for the observed effects. A simple explanation is afforded by the supposition that the readjustment of the components of the yarn under the influence of impacts may take place in a jerky or discontinuous manner, but further work is needed before this explanation can be regarded as well based.

Influence of the Intensity of the Impact

In Fig. 4 are shown the mean curves for the extension of a flax line yarn under various intensities of impact. The various intensities were obtained by changing the position of the set pieces described above, thus altering the height through which the tension pieces fell. The curves were obtained by testing 20 specimens at each intensity. When the proportion of breakage is small, the effect on the mean of omitting the observations of those specimens which have been unable to withstand the full treatment is insignificant in comparison with the probable variation from the true mean due to sampling

* G. F. New, "The Stress-strain Curves of Various Yarns." *J. Text. Inst.*, 1922, **13**, 25-40.

irregularities with 20 specimens. In the present results the proportion of yarn specimens which withstood the full treatment is recorded on each curve. It will be seen that by increasing the intensity of the impact an increased extension is obtained at all stages, the general character of the curve remaining unchanged. On the explanation put forward above, this indicates

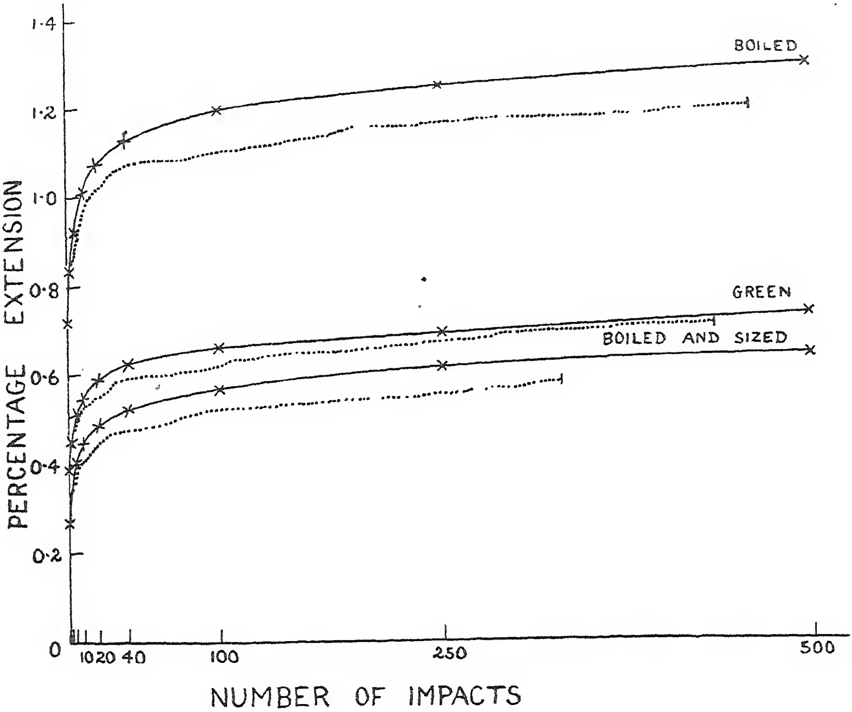

FIG. 5
The influence of boiling and sizing on the extension of a 40 lea flax yarn under the action of repeated impacts. No. 68P–70P.

that the tightening and locking of the fibres is far fom complete, even after 500 of the less intense impacts. That is, although after the first few impacts the extension per impact is of microscopic extent with the less intense impacts, considerable further extension may be produced by applying a greater impact. With the most intense impacts used, however, the total extension is of similar magnitude to the permanent extension of the same yarn loaded slowly between 46·25 and 750 gms. Heavier impacts than those used merely cause early breakage, most of the specimens breaking before reaching the part of the curve where extension per impact is very small.

The Effects of Boiling and Dressing on the Extension of Yarns

In Fig. 5 the continuous line curves are the mean extension-impact number curves obtained from a sample of 40's lea flax line yarn in the green, in the boiled, and in the boiled and sized states. The effect of boiling a yarn is to increase the extension due to an impact treatment. With this particular yarn the mean total extension at 500 impacts shows an increase of nearly 80% over that of the green yarn. After size is applied to the boiled yarn, on the other hand, it is found to be even less extensible than the green yarn, a result which is in agreement with the character of the stress-strain

curves of sized yarns.* A precisely similar decrease in extensibility under impacting is found when flax yarns are wetted and dried under tension. The higher the tension employed during wetting and drying the less will be the subsequent extension on impacting. Matthew† has recently called attention to the effect of such soaking on the stress-strain curves of flax yarns and the observations made in the course of the present work support his conclusions that the changes in the elastic properties of sized flax yarns may be due to the mechanical treatment undergone during sizing rather than to the actual properties or cementing action of the size.

It is of interest to compare the extension of flax yarn under repeated impacts with the results obtained by Owen and Oxley‡ from cotton yarns subjected to an oscillating stress, a treatment somewhat similar to that at present under consideration. These authors found a rapid initial extension which gradually decreased with further stress cycles, in all classes of cotton yarns. The final proportions of the extension curves, however, showed a well-marked difference according as to whether the yarn had been sized or not. A sized cotton yarn extends less and less as the breaking point is approached, behaving in this respect in an exactly similar manner to all flax yarns. An unsized or normal cotton yarn, however, at a certain stage begins to show a gradually increasing extension for each stress cycle and this increase continues until breakage occurs. Owen concludes that the difference in behaviour is due to the cementing action of the size which diminishes the relative displacement or slipping of the cotton hairs. It seems to be clear that the effects of sizing a cotton yarn are more extensive than those produced in a flax yarn.

The Effect of Twist in the Yarn

Extension curves were obtained from a series of 40's lea Courtrai line yarns with twists of $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and $3\times\sqrt{40}$ turns per inch made from the same rove and these curves are given in Fig. 6. A remarkable increase in the extension occurs with increasing twist, showing that the configuration and arrangement of the fibres in the yarn are of far greater importance than the elastic properties of the individual fibres in determining the behaviour of the yarn.

The Nature of the Extension of Individual Specimens

It was considered advisable to examine closely the irregular nature of the extension of the yarn, and from several specimens, therefore, readings were taken after every impact from the first until breakage occurred. Typical results for green yarn and for the same yarn after boiling and sizing are shown by the broken curves in Fig. 5. All show irregularities of various extents. This appears to indicate that most of the slipping, if not all, is caused by units which are not numerous enough to give a smooth curve. Probably, therefore, large strands or agglomerations of strands are the slipping units rather than the fibres within the strands. The fracture of the yarn was in general not preceded by exceptionally increased extension and was frequently preceded by uniform or even reduced extension per impact. The ultimate breakage of flax yarn, therefore, under repeated small impacts is due probably to failure in the structure of the fibre and not to progressive

* A. L. Gregson and G. F. New, *J. Text. Inst.*, **14**, 1923, T447.
† J. A. Matthew, *J. Text. Inst.*, **17**, 1926, T192.
‡ *J. Text. Inst.*, **14**, 1923, T18 and T375.

pulling of the yarn. This conclusion was reached also from the study of the stress-strain curves of yarns* and is confirmed by microscopic observation of the broken ends of yarn.

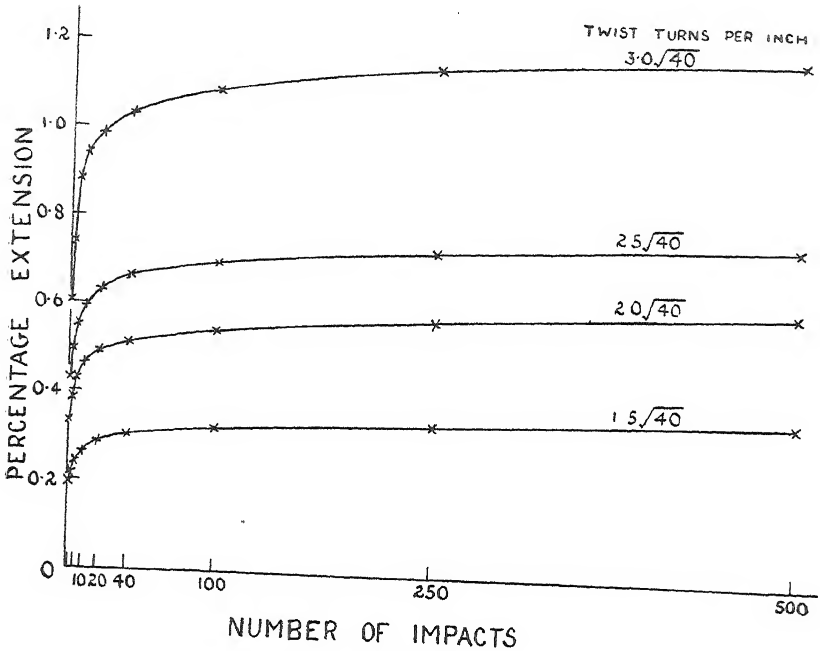

FIG. 6

The influence of the twist of a yarn on the extension under the application of repeated impacts—flax line 40 lea, Nos. 55P–58P.

The Number of Impacts necessary to cause Breakage

A test to destruction was carried out on samples of 100 lea flax line yarn in the green and in the green and sized states, and also in the boiled and in the boiled and sized states; 100 threads of each sample were subjected to impacts until they broke and the number of impacts withstood by each was recorded. The results, which show great irregularity, are given in Table II.

Table II.

100's Flax line yarn. Impact height=2·30 cms.

State of Yarn	Least No. of Impacts which broke a Specimen	Greatest No. of Impacts withstood by a Specimen	Mean No. of Impacts to cause Breakage
Green...	1	> 14,000	678
Green and sized	2	> 9,000	1,137
Boiled	1	1,884	68·3
Boiled and sized	1	3,900	298

Owing to the high irregularity, the mean results, notwithstanding careful sampling, cannot be expected to be very reliable with only 100 specimens, and the above figures are given merely to show the order of magnitude of the

* G. F. New, *loc. cit.*

effects in question. Different yarns and sizes would be expected in this respect to vary greatly, since the protective power of a size will depend on its physical properties in the liquid state, and on the character of the yarn as affecting penetration and adhesion, as well as on the properties of the dried size. The curves given in Fig. 7 of percentage of survivals at various numbers of impacts show clearly the differences attributable to boiling and sizing.

The number of impacts necessary to cause the breakage of a yarn is influenced much less by wetting and drying under tension than by sizing, although the effects of the two treatments on the extensibility are almost identical. Results illustrating this are given in Table III. The two flax yarns used were of widely different character and 100 threads were impacted to destruction in all cases. The tension on the individual threads during wetting and drying was 40 grams—a value which is probably higher than that obtaining in the normal factory sizing operation.

Table III.

Material	No. of Impacts to break Mean	Median
100 lea green line yarn	47·0	10
,, ,, sized	214·3	96
,, ,, wetted and dried	79·1	30
25 lea ½ bleached tow yarn	14·7	5
,, ,, ,, sized	395·3	102
,, ,, ,, wetted and dried	15·5	5

It will be noticed that wetting and drying has a greater effect on the green yarn than on the bleached. This must be due to the presence of the non-cellulosic binding materials in the green yarn, which are softened during wetting and, on drying, cement adjacent strands together more completely. In the bleached yarn such an effect could only take place to a greatly reduced extent. In both the green and the bleached yarn the addition of size would appear to have a pronounced cementing effect. Since in flax yarns the addition of size produces only a slight (5 to 10%) increase in breaking strength the protective effect of the size as regards resistance to repeated impacting must be produced in some other way. These results suggest that the prevention of the disarrangement of the yarn structure constitutes an important part of the protective action of sizes.

In order to examine more fully the changes which may occur in yarns due to repeated impacting, a 60 lea Courtrai line yarn was used, one group of specimens being subjected to a comparatively heavy impact and another group to a lighter impact. In all work of this nature the intensity of the treatment must be kept within such limits that not more than a small percentage of the specimens will be lost through breakage, otherwise the effects which are being studied are masked by the unknown influence of the removal of a number of the weaker specimens on the mean strength as subsequently determined. Fifty specimens of the yarn were tested in a constant rate of loading type of testing machine after having been subjected to each of the following numbers of impacts, 1, 2, 3, 6, 30, and 100 for each intensity of impact. The distance between the clamps in the strength testing machine was 40 centimetres. The specimens were selected from the available yarn in such a manner that disturbing effects of the irregularity of the yarn were

reduced to a minimum. From 50 equally spaced parts of the bulk one specimen was taken for each of the degrees of treatment to be applied. Further, although the work was carried out in a constant temperature and humidity room, ten specimens were tested with each intensity of treatment consecutively, in order to counteract any possible ageing effects in the yarn, and the

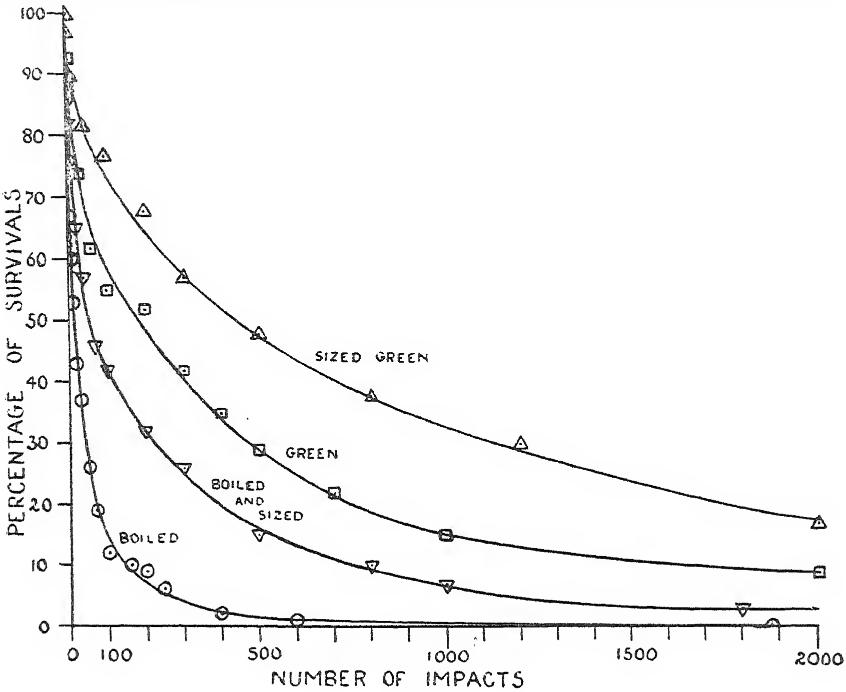

FIG. 7

The number of survivals from 100 specimens of 100 lea Courtrai flax line yarn when subjected to repeated impacts after various pre-treatments. Nos. 210P-213P.

breaking tensions were determined in every case immediately after the application of the impact treatment lest any recovery of the yarn should mask the effects produced. The results, which are given in Table IV., are sufficient to show that any weakening which may be produced by impacting is small enough to be of negligible practical importance in a yarn of this kind.

Table IV.

60's Courtrai flax line yarn. Breaking tension after impacting. (Fifty specimens with each impact.)

No. of Impacts	Mean Breaking Tension (grams)		Mean Breaking Extension (centimetres)		No. broken with 4·50 cms. Impact
	2·30 cms. Impact	4·50 cms. Impact	2·30 cms. Impact	4·50 cms. Impact	
0	848		1·28		—
1	909	844	1·12	1·04	0 out of 50
2	834	890	1·02	1·03	0 ,, 50
3	877	889	1·05	0·98	0 ,, 50
6	859	844	0·98	0·92	3 ,, 53
30	876	874	1·00	0·90	2 ,, 52
100	847	883	0·93	0·91	7 ,, 57

Not only is the mean strength maintained but also the coefficient of variation shows no appreciable increase. For example, the coefficient of variation of the unimpacted yarn is 16, while after 30 impacts it is 15 with the 2·30 cms. height and 17 with the 4·50 cms. height. As was to be expected, the continued extension due to the impacting has the effect of reducing the extension recorded on subsequently breaking the yarn. This feature is shown in the table. However much the yarn is impacted, an extension always remains to be recorded in a subsequent determination of the breaking strength. The approach to constancy of the residual breaking extension after the more drastic impact treatment suggests that most of the permanent extension available in the yarn has been taken up by the more severe impact treatments and that the extensibility remaining is almost purely elastic. Thus with the 2·30 cms. impact, the extension on breaking after 30 impacts is 2·45% and 100 impacts reduces this to 2·29%. With the 4·50 cms. impact, however, after six impacts the extension on subsequent breaking is 2·25%, while 100 impacts only reduce this to 2·23%. It was considered desirable to examine a tow yarn under the same conditions as the line yarn described above, and for this purpose a 45 lea combed Irish flax tow yarn was used. The impact fall for this yarn was 2·50 cms. and the length of the impacted yarn that was tested for breaking tension was 45 cms. The results are given in Table V.

Table V.

45's Combed Irish flax tow yarn. Impact height=2·50 cms.
Breaking tension after impacting (50 specimens at each impact).

No. of Impacts	Mean Breaking Tension (grams)	Mean Extension at break (centimetres)	No. broken by Impacting
0	692	1·06	—
1	656	·84	1 out of 51
2	681	·84	2 ,, 52
10	699	·84	5 ,, 55
100	744	·81	8 ,, 58

It will be seen that the strength does not undergo great changes, the progressive increase in the mean strengths of the yarns with the larger numbers of impacts being attributed to the increasing proportion of failures under impact treatment previously referred to. With this tow yarn the reduction in extension at the breaking tension caused by 100 impacts is substantially smaller than with the line yarn, and the condition of relative constancy of extension previously referred to is approached after one impact.

Similar results have been obtained when other yarns have been subjected to impacts 3,000 times.

Since the tensile strength is not altered by more than a small percentage, as shown by the results in Tables IV. and V., and since the resistance to impacting shows a progressive decrease as impacting proceeds, it would appear that the latter phenomenon is due to changes other than in tensile strength. The yarn, it is known, becomes less extensible and the stresses induced by a given impact energy must therefore increase. The breaking strength may ultimately be reached by reason of this change in extensibility and it is possible also that a progressive disintegration of the yarn structure, as has been mentioned above, may increase the vulnerability to repeated impacts.

Our thanks are due to Mr. S. Alty, M.Sc., for the determination of some of the results incorporated in this paper.

SUMMARY

The tensile stresses imposed on warp yarns by the shedding and the beating-up motions in the loom are discussed. It is pointed out that the maximum stress induced in each individual warp thread depends on the extension properties of that thread; and it is suggested that, in addition to strength and regularity, the feature to be sought for in yarns for good weaving quality is high recoverable extensibility rather than a large total extension to breaking strength, which includes irrecoverable as well as recoverable extension. The effects are discussed of the application to a yarn of repeated impacts by a falling weight and the design of experimental apparatus used to apply such impact treatment is described.

Results obtained with this instrument show that the progressive extension of a yarn under the influence of repeated impacts is irregular, but that a smooth curve may be obtained from the means of the observations of 20 specimens. This mean curve is of the same general form, very closely logarithmic, for all flax yarns and under all conditions examined. The mean extension is rapid with the first few impacts and gradually becomes slower but never decreases to zero.

Typical extension curves are given showing the effects of the intensity of the impact, of the twist in the yarn and of the pre-treatment of the yarn such as boiling and sizing. Some results from observations of boiled and sized yarn are given in the form of survival curves, which show how the number of unbroken specimens decreases with the number of impacts applied, rapidly at first and more slowly later. The order of superiority is the following—Green yarn sized, green yarn, boiled yarn sized, and boiled yarn. It is found that changes in the tensile strength of a yarn due to the application of repeated impacts are insignificant and it is concluded that fractures which take place on the application of repeated impacts are due in part at least to the gradually lessening extensibility of the yarn. This decrease in extensibility necessitates a higher and higher maximum tension for the absorption of the constant energy of impact until the breaking strength is reached.

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41—NOTES ON THE DETERMINATION OF THE DRY WEIGHT OF WOOL

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SUMMARY

The object of this paper is to compare the actual moisture content of wool, referred to as the *true* regain, with the commercial regain as determined by an ordinary conditioning oven or by the Bradford Conditioning House (B.C.H.).

It is found that the commercial regain as determined by the B.C.H. is about ½% low compared with the *true* regain (e.g., 15½% instead of 16%). The Conditioning House uses a type of oven in which the air is preheated and forced through the wool at a temperature of 235–240° F. On the other hand the ordinary commercial gas and electric ovens tested gave a still lower figure, viz., about 1% low (e.g., 15% instead of 16%). It is shown that unless the air be dried by special means the *B.C.H. commercial regain is as near the true regain as practicable, and is therefore satisfactory as a commercial standard,* but the smaller installations in mill use are less perfect. Many ovens are installed in sheds near scouring or finishing plants, or places where gas is burnt, and the air may contain a considerable amount of moisture. It is suggested that those who use their ovens regularly should compare their figures with those of the B.C.H. at frequent intervals so that they may know what correction to apply.*

INTRODUCTION

In the course of certain investigations it is found necessary to determine the exact amount of water present in the wool under test and this requires an accurate determination of the dry weight. The question arises as to how near the percentage moisture calculated on a dry weight obtained under ideal laboratory conditions corresponds with the regain as determined by a commercial oven.

It was first noted by Dietz[1] in 1911 in his work on Specific Heats of Textile Materials that there was a considerable difference between the values given by the two methods. He suggested three laboratory methods for drying out, namely—

(1) The Schopper Conditioning Oven.

(2) A closed desiccator heated on a water bath and partially evacuated to 670 mms.

(3) A tube with a stream of hot dry air passing through it.

The results of the three methods are recorded below—

	% Moisture Content
(1)—Schopper	10·41
(2)—Desiccator	9·58
(3)—Air current	10·92

Dietz therefore decided on method (3) as giving the values most approximate to the real dry weight of the material. Later King[2] in his work on the Specific Gravity of Wool adopted a similar method and this was afterwards repeated by Barritt and King[3] for dry weight determinations in their work on Sulphur Content of Wool. Hedges[4] utilised an absolute method for determination of the dry weight in his work on the heat of wetting of wool,

* Advice will readily be given on this matter by the authorities of the Conditioning House or by the Research Association.

as it was found that the values given by the ordinary gas conditioning oven were often as much as 1% below the true dry weight.

As an outcome of this experience it was decided to conduct a series of experiments comparing the relative efficiency of various types of ovens with the laboratory method. The method employed in the laboratory was deemed to give as near a true dry weight value as possible without damage to the wool, and the percentage of water calculated on this value was taken as the true regain and used as a standard for comparing the values obtained in other ways. It would be better to call this standard value the Moisture Content rather than the regain because, as will be seen later, there is always a small difference, and to leave the latter term with its usual significance, viz., the percentage water calculated on a dry weight value obtained with a commercial oven. No differentiation is made, however, as the term regain is so familiar in the industry, and the value obtained by the standard method is simply referred to as the *true* regain.

LABORATORY METHOD

The method used was similar to the one employed by King[2] for regain determinations in connection with work on the Specific Gravity of Wool, but designed to accommodate about a three times greater weight of wool. The wool was contained in a glass weighing bottle fitted with a ground stopper and inlet and outlet tubes, each with a tap. The bottle was supported in an electric oven of such capacity that in the space occupied by the bottle there was no sensible temperature gradient. Direct heat from the heating element was prevented from falling on the bottle by a system of baffles. A stream of air was drawn slowly through the wool by means of a filter pump. The air was bubbled through concentrated sulphuric acid and passed over calcium chloride before entering the bottle. Another tube of calcium chloride was included between the bottle and the pump to prevent any diffusion of moisture back into the wool. The oven temperature was kept constant at 105°–106° C. (222° F. approx.). The bottle was removed from time to time, allowed to cool in an enclosure over calcium chloride, and then weighed. The process was continued until there was no further loss in weight. The final weight, less the weight of the bottle when empty, was then taken as the true dry weight.

Method of Making Test

The wool used was all taken from one top.* Amounts suitable for use with the oven to be tested were hung in the constant humidity room for several days. A small portion was taken from three different places in each lot and the three pieces, weighing together about 6 grams, were placed in the weighing bottle, and the latter was dealt with as already described. The remaining large portion of the sample was taken and dried out in the oven in exactly the same way as with commercial samples.

Types of Oven Tested

A, B—Gas heated: no special arrangements for drawing air through oven.

C—Air draw· over an electric heater and then through oven.

D—Research Association. Small regain balance.

E—Bradford Conditioning House. Ovens specially designed for the Bradford Corporation in 1923 by the Manager, Mr. E. H. Townend.

*70's Botany, combed.

Results

The following table shows the regain values obtained by the laboratory method and those by the ovens.

Test No.	Type of Oven	Approx. Oven Temp.	Regain % in Oven	True Regain % Laboratory Method	Difference
1	A	230° F.	15·9	16·7	0·8
2	A	,,	15·7	16·7	1·0
3	A	,,	13·8	14·9	1·1
4	B	220° F.	15·2	16·3	1·1
5	B	,,	16·7	16·6	−0·1*
6	C	219° F.	16·0	17·0	1·0
7	C	,,	15·5	16·7	1·2
8	C	,,	15·8	16·7	0·9
9	C	,,	15·5	16·4	0·9
10	D	221° F.	16·1	16·8	0·7
11	D	,,	15·2	16·1	0·9
12	E	235–240° F.	16·0	16·4	0·4
13	E	,,	16·1	16·6	0·5
14	E	,,	16·7	17·4	0·7
15	E	,,	16·7	17·0	0·3

* Badly scorched.

Average difference in tests 1–11, excluding No. 5 = 0·97.
,, ,, 12–15, oven E = 0·47.

For oven E (Bradford Conditioning House) it is seen that the average difference is small, and in the case of the others, the differences, although larger, are all very near the average value of 0·97 low. The difference (·47) for oven E is in good agreement with the results obtained by Dietz already given. He found a difference of 0·51 between the value given by a conditioning oven and his laboratory method.

In the laboratory method dry air was passed through the wool, and this immediately suggested itself as being the cause of the above differences.

Experiments were made in which, instead of drawing dry air into the apparatus, it was drawn from over the top of the oven. (The air contained approx. 3½ grains of moisture per cu. ft.). After there was no further loss of moisture dry air was resorted to and the true regain obtained. The following are the results obtained in this manner.

Air not Dry	Dry Air	Difference
16·2	16·8	·6
16·2	16·7	·5
14·5	14·9	·4
15·8	16·4	·6
16·3	16·7	·4
16·4	16·8	·4

Average difference = ·48.

This average difference is very nearly the same as that between the Bradford Conditioning House figures and the laboratory figures. This seems to indicate that at the B.C.H. the regain value is as near the true regain as can be obtained without the air which is passed through the oven being previously dried.

At the B.C.H. the ovens are kept at a temperature between 235° and 240° F. while the other ovens that were tested were used at lower temperatures. It was thought that this might account for the bigger difference given by these ovens. To test this point the small laboratory oven was used without the air being dried and run as usual at 106° C. (223° F.). When there was no further loss of weight the temperature was raised to 115° C. (240° F.). It was found as the result of several experiments that there was no further loss of water at this higher temperature.

It would appear that the higher oven temperature referred to is unnecessary, and is not the reason for the better results obtained with the B.C.H. ovens. The induced hot air current through these receives considerable previous heating so that it enters with a temperature equal to that of the ovens. Also the mean relative humidity throughout the year of the air which is drawn from the oven room is 45% and the temperature about 75° F.

THEORETICAL NOTE

When wool is placed in an atmosphere of constant humidity and temperature it gains or gives up moisture until the vapour pressure of the absorbed water is equal to that of the water vapour present in the atmosphere. This latter quantity is less than the saturation vapour pressure of water (except at 100% relative humidity), consequently the water present in the wool has a vapour pressure less than that of water under normal circumstances. This lowering of vapour pressure is similar to that which takes place in the case of solutions. In the case of water solutions of non-volatile salts this lowering of vapour pressure causes the boiling point of the solutions to be higher than that of the pure solvent. In the same way wool has to be heated above the boiling point of water in order to drive the contained moisture off as vapour.

It has been shown that no more water is removed by heating at 115° C. than at 106° C., and that to remove what are presumably the last traces of moisture dry air must be passed through the wool. The water that is removed in this way is probably held in the wool in a different way to the bulk, which can be removed by heating at 105° C. It has been suggested elsewhere[4] that this water is that which is adsorbed by the actual colloidal particles which constitute the wool substance. That the attraction for this water is very great is indicated by the large value of the heat of absorption which is obtained at zero regain[4], and this would account for the difficulty experienced in removing the last ½% of water.

In conclusion, the authors wish to express their thanks to Mr. E. H. Townend, Manager, Bradford Conditioning House, for his hearty co-operation during the experimental work and the writing of this paper.

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42—THE GEL STRUCTURE OF THE WOOL FIBRE

By John B. Speakman, M.Sc.

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ABSTRACT

It has been shown that the wool fibre possesses a true yield point and, after extension, remains *permanently* more extensible at low tension. These observations necessitate fundamental changes in Shorter's views on the internal mechanics of fibres. Instead of possessing the usual two-phase structure of gels, namely, a fibrillar structure and enclosed viscous medium in physical equilibrium with one another, it is found that the wool fibre consists of two gels arranged, so to speak, in parallel. The first of these may be called the *petrified* gel and comprises an elastic cell wall enclosing a fibrillar structure *which is not in physical equilibrium with a viscous phase.* The second, which fills the interstices of the petrified gel, is gelatinous and capable of reversible solution in, and deposition from, water. Gelation occurs at 0° C. in water and at ordinary temperatures in unsaturated air and, under such conditions, the medium possesses the usual two-phase structure of gels. In reality, therefore, the wool fibre consists of four phases but, for convenience of specification, it will be considered here as possessing only three—

1—An elastic cell wall enclosing

2—A fibrillar structure which is not in physical equilibrium with

3—A viscous medium of gelatinous character included in its interstices.

INTRODUCTION

When a wool fibre is subjected to tension, it shows an immediate extension followed by slow creep; conversely, when an extended fibre is released, it shows an immediate partial recovery followed by slow retraction. Such behaviour is by no means peculiar to wool but is characteristic of a wide range of substances including most gel structures, glass, and metals. Poynting and Thomson[1] have developed a mechanical model to explain and illustrate the phenomenon, which is generally known as "elastische Nachwirkung," and the model has recently been adapted by Shorter[2] and by Poole[3] to explain the elastic properties of wool and gelatin gels, respectively. It consists essentially of two springs connected in series, the one spring being free and the other moving within a viscous medium. Under tension, such a model would show the characteristic immediate extension followed by slow creep, and in consequence Shorter was led to conclude that the wool fibre consists of three sets of elements—

(1) Elastic elements which extend and contract freely, coupled to

(2) Elastic elements which are impeded in their extension and contraction by

(3) Elements which act as a resistant medium.

No attempt was made to correlate these arbitrary divisions of the fibre with its known microscopic structure, but the third set of elements were found capable of fairly precise definition. They were said to "partake of the nature of a gelatinous fluid, whose impeding effect diminishes or increases as the water content of the fibre increases or diminishes."[4] The evidence in favour of their colloid character is as follows—"the extensibility at low tension is increased by subjection of a fibre to a high tension. This is simply an instance of the diminution of the viscosity of a colloidal solution caused

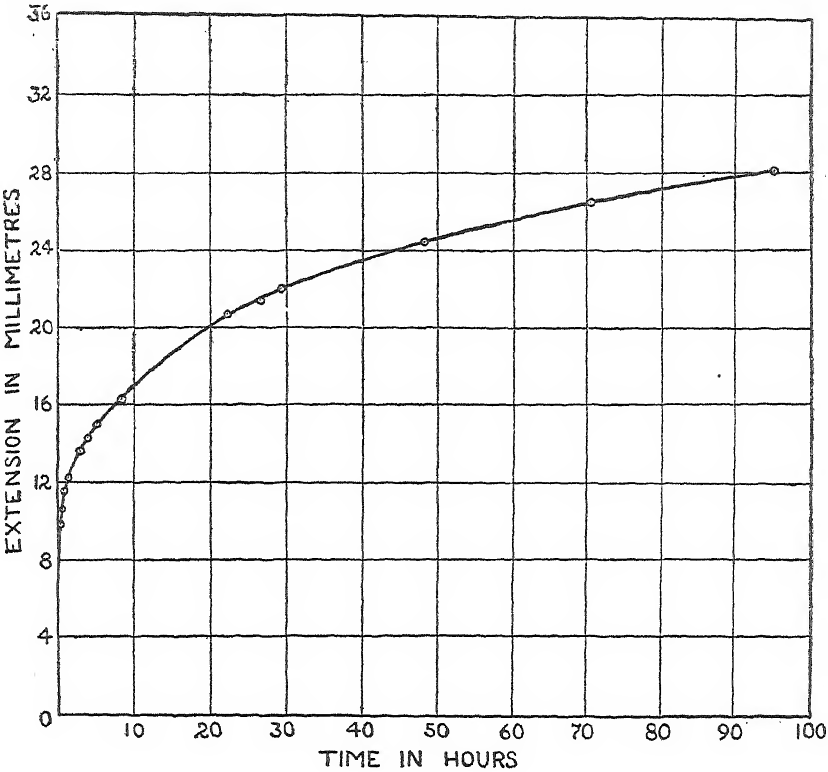

FIG. 1

by excessive mechanical disturbance."[5] "This effect is only temporary, the viscous phase reverting to its former state in a few days."[6]

This theory of fibre structure suggests a remarkable analogy between wool and gelatin gels, but provides no explanation of their obvious differences. It would indeed be surprising if wool, which is a limited-swelling gel, is insoluble in water and possesses a definite cellular structure, were so similar in detail to gelatin gels with precisely opposite characteristics. Shorter's discovery that, while gelatin gels readily assume permanent set, the wool fibre is perfectly elastic up to 42% extensions, has received no adequate explanation and appears to prevent general acceptance of his theory.[7] While, therefore, the theory constitutes a distinct advance in the study of fibre elasticity, it can in no way be regarded as complete.

The present investigation did not, however, take its origin in these considerations but in the accidental discovery that a once-extended wool fibre, contrary to Shorter's contentions, shows no tendency to recover its

pristine strength but remains permanently more extensible at low tension. Such an observation has far-reaching consequences; it indicates either that the mechanism of the fibre's adaptation to stress is not as the theory supposes or that the viscous medium is non-gelatinous.

EXPERIMENTAL

Behaviour of the Mechanical Model under Stress

The key to the elucidation of gel structures is usually to be found in a study of their behaviour under stress. Poole[3] has shown that the rate of extension under stress of the mechanical model already described is such that a linear relationship must hold between dE/dt and E, where E is the extension at time *t*. Further, the slope of the dE/dt : E curve is independent of the stress. These deductions were experimentally realised in the case of gelatin gels, within limits fixed by their imperfect elasticity. The agreement between theory and experiment should be even closer in the case of the wool fibre, which is perfectly elastic up to 42% extensions at least. Data illustrating the rate of extension of a wool fibre under constant *stress* in saturated air are given in Table I. and Fig. 1.

TABLE I.

Cotswold Fibre. No Medulla. 5·010 cms. long. 0·00430 cms. diameter.

Stress $= 6{\cdot}89 \times 10^5$ g. per cm.^{2}

Time in Minutes.	Mms. extension
0	0·00
1·667	9·15
3	9·70
5	10·10
10	10·65
32	11·55
69	12·25
158	13·65
226	14·40
300	15·10
486	16·35
1327	20·75
1588	21·45
1742	22·10
2889	24·55
4226	26·55
5688	28·10
7243	29·70
8580	30·65
10009	31·55
11522	32·25
12909	32·75
14362	33·20
15876	33·70
17340	33·95
18682	34·30

The corresponding vaules of dE/dt and E deduced from this curve are given in Table II.

TABLE II.

E. mms.	dE/dt. mms. per minute
10·0	0·165
10·5	0·096
11·0	0·049
11·5	0·028

The relationship between E and dE/dt is obviously not linear and there is therefore additional reason to suppose that the mechanical model aforesaid is in no way a true representation of the wool fibre. Further, it is obvious that Poole's method of investigating the elastic properties of gelatin gels can be of no service in elucidating the gel structure of wool.

Stress-Strain Diagrams

A possible alternative method of investigation is by the study of stress-strain diagrams, but the use of such a method in the present case is complicated by the fact that the wool fibre does not come to equilibrium extension immediately stress is applied. The figures of Table I. show that an immediate small extension does occur but that the creep which follows is of such a different order of magnitude from that which obtains in the case of, say, metals, as to justify Shorter's conclusion that "strictly speaking, there is no such thing as a stress-strain diagram of a fibre; the diagrams so-called are really stress-strain-time diagrams."[18] There appear to be two possible ways of overcoming the difficulty—Either to perform the extensions so rapidly that creep is largely eliminated; or to load the fibre in small increments up to the breaking load, allowing it to come to equilibrium under each load before increasing it. The former method was employed by Shorter, the latter is the one followed in the present paper. Each has its peculiar advantages, but the slow method is of particular value in the study of what may perhaps be termed the "ultimate properties" of the fibre.

Computation of Stress

Any investigation of the stress-strain relationships of the wool fibre is complicated by the fact that its diameter is rarely, if ever, constant along its length, while its cross-section may be circular or elliptical. Accurate computation of stress is therefore impossible, and different authors have adopted various expedients to obtain approximate values. Hardy[9], for example, measured the diameter of the fibre at four different points along its length; the smallest of these figures was in each case used in computing its tensile strength. The assumption involved in this procedure, namely, that the fibre breaks at its thinnest part, has been shown by Bowman[10] to be unwarrantable. A second practice has been to measure the diameter of the fibre at the point of break after the experiment. This again is subject to serious error because the fibre does not always break at right angles to its length, and because the diameter measured is not the diameter at the moment of breaking but a value intermediate between this and the original diameter, on account of elastic recovery. In view of these difficulties an examination of various English wools was made with a view to discovering the least defective in the matter of irregular diameter. A Cotswold wool was finally chosen; it had been commercially soap scoured, followed by extraction with ether in a Soxhlet apparatus. The value of the diameter used in computing stress was arrived at as follows. The five centimetre length of fibre to be tested was calibrated at 30 to 35 points along its length and the mean diameter taken. The difference between the "square of the mean" and the "mean square" diameter was so small as to allow the former to be used without appreciable error in computing stress. The degree of irregularity of the wool is indicated in subsequent tables where the average deviation from the mean as well as the mean diameter is given.

Humidity

The hygroscopicity of wool, and its greater extensibility when wet than when dry, render control of humidity imperative in the experimental study of its elasticity. Consideration of the properties of the hypothetical viscous phase of the fibre suggests that it will show the phenomenon of creep at all humidities, but that the rate of approach to true equilibrium will be greater the higher the humidity. All the succeeding experiments were therefore carried out in an atmosphere saturated with water vapour. The magnitude of the viscous resistance within the fibre was considered to be dependent mainly on the amount of water absorbed, and as this changes only slightly with temperature at constant relative humidity, the first experiments were carried out at room temperature (18° C.).

Apparatus

The apparatus employed was of a simple character, and is shown in Fig. 2. A five centimetre length of fibre was attached by means of sealing wax to two glass hooks A and B, and its diameter measured, as already described, at 30-35 points along its length. After calibration, the fibre and its accompanying hooks were introduced into the apparatus as shown, the upper hook A being ground into its socket. When in position the fibre had water above it in the trough T and below in the cup C, which was detachable. The exact length of the fibre was measured *in situ* by means of a travelling microscope sensitive to 0·05 mm. Subsequent procedure was simply to load the fibre directly, first with a light copper foil pan (1g.) followed by increments of 1 gram.

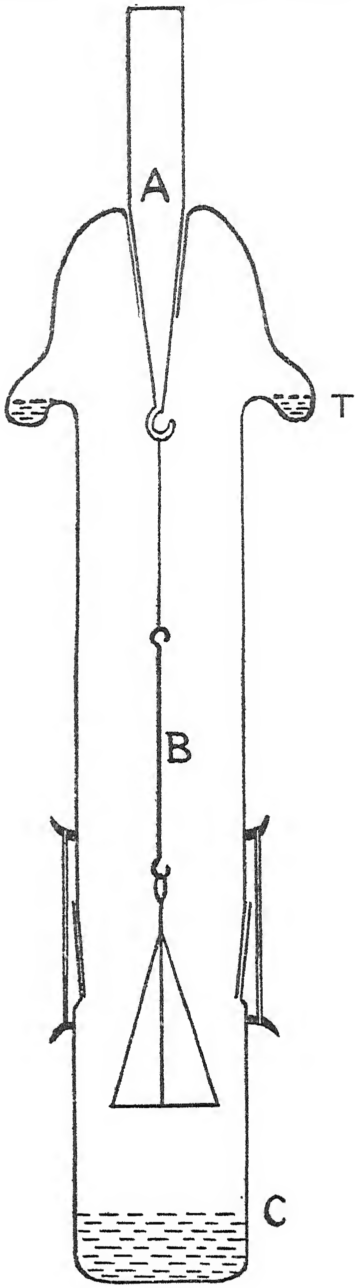

Fig. 2

Experimental Results

Typical stress-strain diagrams are shown in Fig. 3, the values of stress at any point being calculated on the assumption that the volume of the fibre remains constant during extension. The curves are all composed of three distinct sections, each of which has a particular physical significance.

Section 1.—Up to a stress of about $4{\cdot}0 \times 10^5$ g. per cm.^{2} and an extension of about 2%, all fibres approximately obey Hooke's Law. Within this

range, fibres do not appear to show the phenomenon of creep in any reasonable period of time; they may be subjected to stress for two hours without any perceptible motion taking place. If creep does occur, it is of a very different physical nature and totally different order of magnitude from that occurring in the second portion of the curve. Further, the fibres are perfectly elastic within the limits already specified, an *immediate* recovery of length taking place as soon as stress is removed. It is therefore possible, for the first time, to obtain a true value of Young's Modulus for the wool fibre in

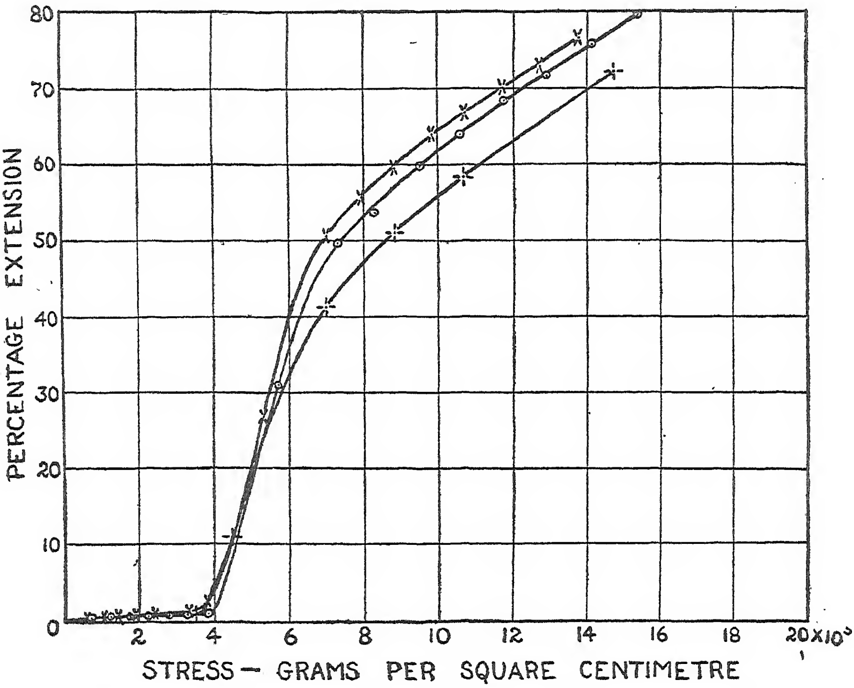

FIG. 3

saturated air. The mean of 35 determinations was found to be $2{\cdot}07 \times 10^7$ g. per cm.², but a high degree of accuracy is not claimed on account of the irregular diameter of the fibres. It must therefore be concluded that below the critical stress of $4{\cdot}0 \times 10^5$ g. per cm.² the fibre extends as a complete unit without any relative motion of its parts.

Section 2.—Beyond this critical stress the character of the fibre is completely changed. It is highly extensible, shows the phenomenon of creep to a very marked degree and its recovery from strain, although complete, is not immediate but occupies an appreciable time. Even under constant *stress* the fibre continues to extend for many days, as shown in Fig. 1, but at an ever decreasing rate; it appears to tend to a definite equilibrium extension which would, however, be attained only after the lapse of an enormous time. A purely arbitrary decision was therefore taken to allow each load to act on the fibre for 48 hours before increasing it by one gram. Under such conditions, it was found that fibres took from 7–21 days, depending on their diameter, to reach the breaking point. The high order of con-

stancy and reproducibility of the results to be communicated later in the paper, constitute a very strong justification for the adoption of this arbitrary procedure. In any event, the time allowed for creep to occur is sufficient to eliminate to a very large degree disturbing effects due to the viscous medium. The sharp inflexion in the stress-strain diagrams at the critical stress has the appearance of being a "yield point," but the fibre remains perfectly elastic even when this stress is exceeded. Nevertheless, it will be shown by a study of the behaviour of once-extended fibres on reloading, that the point of inflexion is a true yield point. The wool fibre is therefore unique in possessing a yield point which precedes the elastic limit.

Section 3.—The preceding period of high extensibility is succeeded by one of lesser extensibility and there is again a tendency for Hooke's Law to be obeyed, although the value of Young's modulus is less than over the first Hooke's Law portion. The incidence of the second point of inflexion is not easily correlated with either stress or percentage extension; it may occur when the stress is between 6 and 9×10^5 g. per cm.^{2} and the extension between 40 and 70%. After the yield point, therefore, Young's modulus increases up to an approximately constant value. Poole has shown, on the basis of his fibrillar theory, that in the case of gelatin and similar gels the value of the modulus should become constant at about 60% extensions. At first sight there appeared to be some justification for explaining the occurrence of a second point of inflexion in terms of Poole's theory, but, as might be expected in view of the lack of correlation with percentage extension, this is not the true interpretation.

Extension at Break and Breaking Stress

Measurements of strength and extensibility have often been made the basis of comparison of different wools, but the numerous recorded investigations are all subject to serious error. The rate of loading single fibres was, for example, never controlled. It is a matter for little surprise, therefore, that the values of breaking stress and extension at break so obtained should be widely discordant even for fibres from the same class of wool. One author[11] goes so far as to state that "the breaking strength of medium and coarse wool varies with some power of the diameter which lies somewhere between the first and second . . . ; the breaking strength of fine wool does not vary directly with the area of the cross-section but with a value which is very close to the first power of the diameter." The inaccuracy of these conclusions is shown by the results of the present investigation which are given in Table III. From first principles, in view of the air spaces within the medullary cells of medullated fibres, it is to be expected that they will be weaker than non-medullated fibres. The results for each class of fibre are therefore given separately.

These results present many features of interest. In the first place, the extension at break of single fibres is far in excess of previously recorded values, the next highest being Shorter's 42%. Also, if due regard is had for their irregular diameter, it will be conceded that the extension at break of single fibres is remarkably constant. Finally, the strength of medullated and non-medullated fibres is directly proportional to their cross-sectional area, although the former are weaker than the latter as was to be expected.

TABLE III.

Breaking Stress and Extension at Break of Cotswold Fibres.

1—Non-Medullated Fibres

No.		Diameter (cms.)		Percentage Extension at break		Breaking Stress (g. per sq. cm.)
1	...	$0{\cdot}00277 \pm 0{\cdot}00032$	...	67·1	...	$1{\cdot}53 \times 10^6$
2	...	$0{\cdot}00300 \pm 0{\cdot}00022$	...	68·1	...	1·44
3	...	$0{\cdot}00305 \pm 0{\cdot}00019$	...	69·4	...	1·63
4	...	$0{\cdot}00329 \pm 0{\cdot}00023$	...	65·6	...	1·61
5	...	$0{\cdot}00354 \pm 0{\cdot}00025$	...	82·0	...	1·74
6	...	$0{\cdot}00359 \pm 0{\cdot}00030$	...	59·5	...	1·18
7	...	$0{\cdot}00372 \pm 0{\cdot}00014$	...	76·9	...	1·60
8	...	$0{\cdot}00386 \pm 0{\cdot}00017$	...	69·1	...	1·76
9	...	$0{\cdot}00389 \pm 0{\cdot}00025$	...	62·9	...	1·24
10	...	$0{\cdot}00396 \pm 0{\cdot}00024$	...	75·7	...	1·56
11	...	$0{\cdot}00432 \pm 0{\cdot}00017$	...	76·4	...	1·36

Mean percentage extension at break = 70·2.
Mean breaking stress = $1{\cdot}51 \times 10^6$ g. per sq. cm.

2—Medullated Fibres

No.		Diameter (cms.)		Percentage Extension at break		Breaking Stress (g. per sq. cm.)
1	...	$0{\cdot}00429 \pm 0{\cdot}00024$	...	77·1	...	$1{\cdot}14 \times 10^6$
2	...	$0{\cdot}00432 \pm 0{\cdot}00015$	...	81·0	...	1·42
3	...	$0{\cdot}00480 \pm 0{\cdot}00040$	...	71·4	...	1·19
4	...	$0{\cdot}00484 \pm 0{\cdot}00035$	...	66·9	...	0·99
5	...	$0{\cdot}00495 \pm 0{\cdot}00036$	...	59·8	...	0·96
6	...	$0{\cdot}00501 \pm 0{\cdot}00024$	...	65·9	...	1·15
7	...	$0{\cdot}00524 \pm 0{\cdot}00038$	...	77·0	...	1·30
8	...	$0{\cdot}00536 \pm 0{\cdot}00029$	...	62·5	...	1·25
9	...	$0{\cdot}00562 \pm 0{\cdot}00032$	...	79·0	...	1·33
10	...	$0{\cdot}00562 \pm 0{\cdot}00056$	...	64·3	...	1·06
11	...	$0{\cdot}00614 \pm 0{\cdot}00035$	...	80·7	...	1·34

Mean percentage extension at break = 71·4.
Mean breaking stress = $1{\cdot}20 \times 10^6$ g. per sq. cm.

Fundamental Constants and their Use

It is therefore possible to formulate three further constants for the Cotswold wool fibre in saturated air. Their absolute values are valid only so long as the method of experiment already described is adhered to, and in this sense they are not so fundamental as the critical stress (yield point) previously defined. The constants are—

(1) Extension at break = 70·8%.

(2) Breaking stress of non-medullated fibres = $1{\cdot}51 \times 10^6$ g. per cm.^{2}

(3) Breaking stress of medullated fibres = $1{\cdot}20 \times 10^6$ g. per cm.^{2}

These results are obviously capable of extended application in fibre testing; it should be possible to obtain results with a single fibre which are normally possible only when hundreds of fibres are tested to obtain a "reliable" mean value. In order to demonstrate the possibilities of the method, Cotswold fibres were subjected to a variety of processes and then tested as described. The results are given below.

(1) *Diazotised Wool.*—The wool was diazotised by means of sodium nitrite and acetic acid, excess acid being afterwards removed by prolonged washing in running water.

Kind of Fibre		Diameter (cms.)		% Extension at break		Breaking Stress (g. per sq. cm.)
No Medulla	... ...	$0{\cdot}00326 \pm 0{\cdot}00023$	...	45·8	...	$0{\cdot}92 \times 10^6$
No Medulla	... ...	$0{\cdot}00424 \pm 0{\cdot}00025$	...	44·0	...	1·02
Medulla ...	... ...	$0{\cdot}00497 \pm 0{\cdot}00037$	...	45·9	...	1·02

The extensibility and breaking stress of wool are therefore greatly reduced by deamination. Trotman's[12] contention that the tensile strength and elasticity (? extensibility) of *yarn* are unaltered by diazotisation must be regarded as deceptive.

(2) *Formaldehyde.*—The action of formaldehyde on wool is of commercial importance. The wool was treated with 40% formaldehyde solution for 15 minutes and the excess reagent removed by washing in cold water. The fibre tested was non-medullated and its diameter=0·00342±0·00015 cms.

Percentage extension at break = 50·2%.

Breaking stress = $1{\cdot}25 \times 10^6$ g. per sq. cm.

The extensibility of wool is therefore reduced by treatment with formaldehyde but its strength is not greatly altered, being, if anything slightly reduced.

(3) *Quinone.*—A patent by Meunier[13] claims that the strength of wool can be increased by treatment with a solution of quinone in cold water for 24–48 hours. The fibre tested had traces of medulla and was 0·00411±0·00034 cms. diameter.

Percentage extension at break = 57·2%.

Breaking stress = $1{\cdot}31 \times 10^6$ g. per sq. cm.

The strength of wool is not markedly increased by the process while its extensibility is reduced.

(4) *Boiling.*—The sample was treated with boiling water for 15 minutes. The fibre tested was medullated and had a diameter of 0·00480±0·00019 cms.

Percentage extension at break = 61·6%.

Breaking stress= $1{\cdot}00 \times 10^6$ g. per sq. cm.

The extensibility and strength of wool are reduced by boiling.

(5) *Chlorine.*—The wool was treated with chlorine in aqueous solution, the degree of action being regulated by periodic observation under the microscope. The first fibre in the table below was treated until all the outer scales were removed, the interior of the fibre being at the same time attacked; the second fibre was treated for a less time.

Kind of Fibre	Diameter (cms.)	% Extension at break	Breaking stress (g. per cm.²)
Medullated ...	... 0·00380±0·00036 ...	40·2 ...	$0{\cdot}88 \times 10^6$
Medullated ...	... 0·00426±0·00024 ...	61·9 ...	$1{\cdot}13 \times 10^6$

The action of chlorine on wool is therefore to reduce both extensibility and strength, the degree of reduction depending on the degree of action.

The results thus obtained for the action of formaldehyde, boiling water, and chlorine on wool, are in complete conformity with general information in textile technology, and the preceding examples should therefore serve to demonstrate the utility of this method of testing textile fibres.

Rate of Recovery of Wool Fibres from Strain

Shorter has shown that the wool fibre is perfectly elastic up to 42% extensions at least. The apparent contradiction between the two properties of the fibre, namely, "elastische Nachwirkung" and perfect elasticity, has led certain observers to doubt the truth of Shorter's observations. As, also, the extensions realised in the present investigation are so greatly in

excess of previously recorded values, the elasticity of the wool fibre obviously needs further study.

Early experiments were carried out with the apparatus already described, and it was found that all fibres were perfectly elastic up to 70% extensions. An attempt was made to measure the *rate* of recovery from strain in conjunction with observations on the ultimate recovery. The results obtained were, however, somewhat irregular in the sense that the time for complete recovery from high extensions was not always greater than that from small extensions. The irregularity was attributed to the fact that, in removing the cup C for the purpose of releasing the fibre, introduction of a small amount of unsaturated air from the surroundings was unavoidable; the hook B was, of course, made very long (5 cms.) to avoid disturbing the air in the immediate neighbourhood of the fibre. In subsequent work the apparatus was modified as follows. The fibre was attached to two glass hooks as before, the lower hook being made extremely short and light. A fine thread led from the lower hook to the outside load through a pinhole in the centre of an annular cup, filled with water, which closed the lower end of the apparatus. Release of stress was effected by burning the thread where it emerged from the pinhole and an instantaneous zero was obtained. Under these conditions the rate of recovery of extended fibres was found to be extremely rapid and the construction of a complete time-extension curve is impossible without the development of a photographic method which is being attempted. Below 40% extensions the recovery from strain is almost instantaneous and no observations of the rate of recovery are possible, but at higher extensions the later stages of recovery can be studied. The results tabulated below refer to a non-medullated fibre whose diameter was 0·00368 cms. The data for 65% extension were obtained by re-extending the fibre after recovery from the 40% extension.

TABLE IV.

Time		Percentage Extension	Time		Percentage Extension
0′ 0″	...	40·0	0′ 0″	...	65·0
0′ 11″	...	1·1	0′ 13″	...	8·5
1′ 0″	...	0·7	0′ 33″	...	4·6
2′ 0″	...	0·6	1′ 0″	...	3·2
			3′ 0″	...	2·0
			6′ 0″	...	1·7
			12′ 0″	...	1·3
			17′ 0″	...	1·1

In the light of these results there can be no doubt that the wool fibre is perfectly elastic up to 70% extensions, i.e., up to the breaking extension.

Before concluding this section of the paper, however, one very curious observation must be recorded. Comparison of the results obtained with the original and modified apparatus revealed the fact that the retardation of the recovery, when an extended fibre is exposed to unsaturated air while the load is removed, is not equal to the time of exposure. There is no discontinuity in the recovery curve, and the retardation persists throughout its course, as shown by the following figures, which are typical.

TABLE V.

Time		Percentage Extension
0′ 0″	...	67·3
0′ 27″	...	24·3
1′ 8″	...	17·7
1′ 35″	...	16·6
2′ 0″	...	15·9
3′ 0″	...	14·4
5′ 0″	...	12·2
18′ 0″	...	8·9
72′ 0″	...	6·9
176′ 0″	...	5·7

The reason for this phenomenon will become evident during the development of the later sections of the paper.

Extension of Previously-Strained Fibres

The results of Table IV. were, as already stated, obtained with one fibre which was re-extended after recovery from one extension to obtain results at a higher extension. In agreement with Shorter's observations, it was found that extension took place much more easily after previous straining of the fibre. A fibre left unstrained for a period of 12 hours did not, however, show a marked recovery of strength and the question of "structural recovery" was investigated.

A fibre was first extended 49·2% of its length in saturated air and then allowed to recover. The stress-strain diagram is shown in Fig. 4 (1). Reloading was commenced immediately afterwards (23′) and curve 2 obtained. The fibre was in this case extended 62·4% and the earlier yield point indicates a complete breakdown of the internal structure as a result of the first extension. Recovery was again allowed to occur and, in addition, the fibre was kept 42 hours in saturated air followed by six hours in room air (25° C.). Reloading was then performed, giving curve 3, which illustrates how little, if any, recovery takes place in a period of 48 hours. This third extension was carried only a little further than the second, viz., 65·7% compared with 62·4%, and should have the effect of forcing curve 4 into a position slightly to the left of curve 3. In the event of any structural recovery taking place the curve would appear to the right of curve 3. The fibre was allowed to recover its length and then kept in saturated air for 40 hours, followed by 77 hours in room air. Even after the lapse of this time the reloading curve (4) still lay to the left of curve 3.

Finally, another fibre was extended 50% of its length and then left unloaded in saturated air for 14 days before re-extending. No tendency whatsoever for structural recovery to occur could be detected. Wool fibres are therefore permanently damaged by extension in saturated air, and the first sharp inflexion in the stress-strain diagrams is a true yield point, which is not the elastic limit.

A review of the results so far communicated indicates how complicated and contradictory are the elastic properties of wool; it is perfectly elastic up to 70% extensions but has, nevertheless, a true yield point in the sense that a once extended fibre is permanently more extensible at low tension. Further, it shows the phenomenon of "elastische Nachwirkung," which is usually associated with imperfect elasticity, to a very marked degree.

Once it has been shown that a wool fibre is permanently damaged by extension, Shorter's simple theory becomes incapable of giving a complete

explanation of its elastic properties, and modification of the existing theory is imperative. The colloid character of the viscous medium appears to be questionable in view of the non-recovery of structural properties after extension, and this phase of the problem was therefore examined.

Effect of Temperature on the Elastic Properties of Wool Fibres

Curiously enough, the effect of temperature on the elastic properties of wool appears never to have been investigated, although this affords an obvious

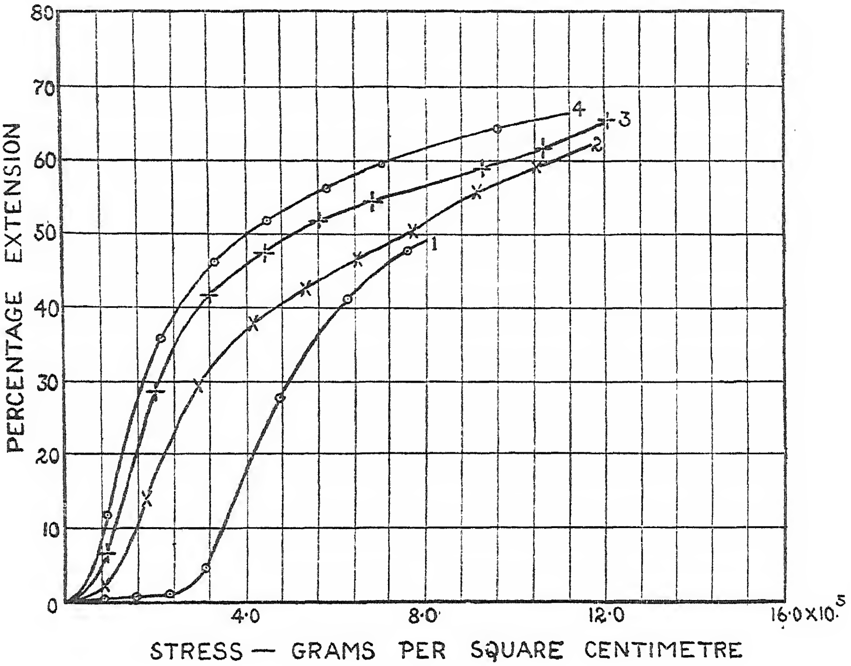

FIG. 4

means of studying the nature of the hypothetical viscous medium of the fibre. If it is gelatinous, its viscosity should increase rapidly with falling temperature. That such is the case became evident from the stress-strain relationships of a fibre at ice temperature The fibre, immersed in water surrounded by a double jacket of ice, was stretched upwards by means of a load applied over a "frictionless" pulley. Loading was performed as already described and the fibre took 14 days to reach the breaking point. The percentage extension at break was 65·0%, and the breaking stress $20{\cdot}9 \times 10^5$ g. per sq. cm. In other words, the percentage extension at break is unchanged at ice temperature, but the breaking stress is almost doubled. (Medullated fibre.) It is significant that the yield point remains unchanged at about $4{\cdot}0 \times 10^5$ g. per sq. cm.

The stress-strain diagrams of fibres in saturated air at 21°, 25°, and 33°C. were, however, not *markedly* different from those at room temperature. For example, the mean breaking stress of 14 medullated and non-medullated fibres at 25° C, was found to be $13{\cdot}32 \times 10^5$ g. per sq. cm. as compared with $13{\cdot}55 \times 10^5$ g. per sq. cm. at room temperature. The results recorded in Table III. are not therefore vitiated by the absence of accurate temperature control.

The experiments at ice temperature constitute a proof of the gelatinous character of the viscous phase, and comparison of the results at 0° C. with those at 21°, 25°, and 33° C. indicate that in all probability the viscous phase sets to a gel at ice temperature.

These results, while verifying the colloid character of the viscous phase of wool fibres, render the explanation of the absence of structural recovery of extended fibres and of the non-coincidence of the yield point and elastic limit, even more elusive.

Internal Structure of the Cells of the Wool Fibre

The final link in the chain of evidence is given by Nathusius' [14] studies of the internal structure of the fibre cells. He showed that the cells composing

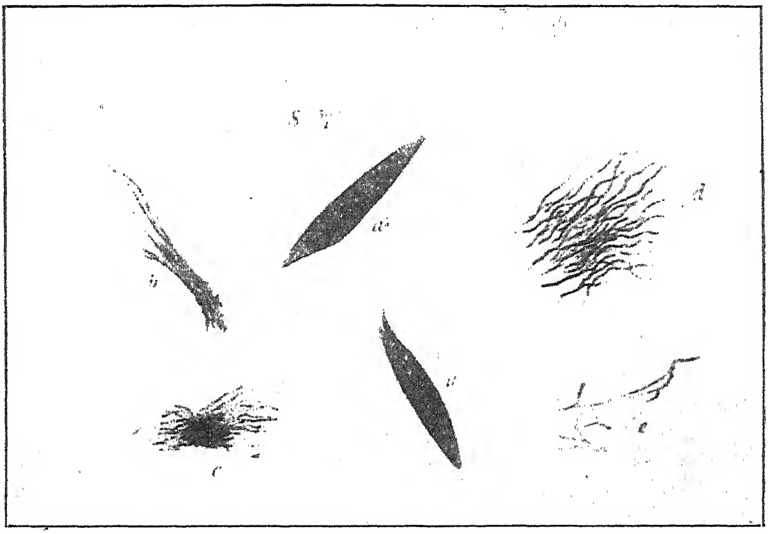

FIG. 5

wool, hair, and feathers can be separated from one another by treatment with dilute ammonia at low temperatures for many days. In some cases the cell wall was ruptured and the contents revealed. These were found to consist of long threads or fibrillæ about 1μ diameter, no matter from what source they were derived. Nathusius' diagrams are reproduced in Fig. 5, and they convey the impression that the majority of the fibrillæ run parallel to the length of the spindle-shaped cells (*b* and *d*) while some (*e*) are arranged haphazardly. These observations serve to reconcile the apparently contradictory evidence of the present paper and give the key to the elucidation of the gel structure of the wool fibre.

THEORETICAL

The Gel Structure of the Wool Fibre

It is known that the cells which go to form wool are originally spherical in form but, as they are forced up the shaft of the fibre, deformation to either scale or spindle shape takes place. The contents of the original cell are probably gelatinous in character and, during deformation, there will be a tendency to develop fibrillæ parallel to the length of the shaft rather than at an angle to the length. This is in keeping with Nathusius' microscopic observations. Further, there is reason to suppose that chemical changes

(condensation &c.) proceed at the same time. The exact nature and extent of these changes will probably differ in the fibrillæ and viscous medium on account of mass action considerations, and the theory to be formulated supposes that when the cell emerges from the skin as an integral part of the fibre its fibrillæ are not in physical equilibrium with the viscous medium. In other words, the fibrillæ and cell wall form a kind of petrified gel, incapable of solution in water. The interstices of this structure are filled with a true colloid capable of reversible solution in, and deposition from, water. As previously stated, the solution in equilibrium with water or saturated air probably sets to a gel at 0° C.

The behaviour of such a structure under stress is considered to be as follows. Under small stress, extension is determined by the elastic constants of the cell wall and fibrillæ. No displacement of the fibrillæ relative to one another occurs, and Hooke's Law is obeyed. At a certain critical stress the fibrillar structure begins to break down and a definite yield point, accompanied by rapid extension, is observed. The rapid extension probably occurs in two ways; by rotation of detached fibrillæ and by their slip past one another in the viscous medium. Increasing stress increases the extension but at a certain critical stress, the exact magnitude of which depends on the conditions of loading, the elastic cell wall tightens on its contents and extension is retarded. This retardation is due to the reduction of the rate of slip of fibrillæ past one another, but, even under the breaking stress, slip is not entirely eliminated. The preceding observations serve to explain the existence of a second point of inflexion on the stress-strain diagrams for wool fibres.

In the case of gelatin gels, Poole accounts for the increase of Young's modulus with increasing extension by supposing that the fibrillæ rotate until at some limiting extension they all lie in the line of application of stress; thereafter, the modulus is constant. He was unable to realise this condition with gelatin gels on account of their small extensibility, but with organosols of cellulose acetate much closer approximation to the theory was observed. No such explanation can hold for wool fibres, however, because, as the extension of previously strained fibres indicates, the breakdown of the fibrillar structure, once accomplished, remains permanent. Some attempts to promote structural recovery have already been described, but many others have been made. For example, extended fibres were allowed to recover their length and then heated in boiling water without any tendency to recover structural properties being detected. This lack of continuity in the fibrillar structure of extended fibres precludes any application of Poole's theory to wool. It is not, however, contended that fibrillar rotation *per se* plays no part in determining the inflexion of the stress-strain diagrams. On the contrary, the essential condition of "tightening of the cell wall" probably cannot be fulfilled until all fibrillæ have been drawn into the line of application of stress.

The perfect elasticity of wool is readily explained. When an extended fibre is released, the elastic cell wall, which is highly extensible, pulls back the contents until its original shape, i.e., perfect recovery, is attained. The non-recovery of structural properties is, however, accounted for by the postulate that the fibrillar structure is not in physical equilibrium with the viscous phase.

An important observation, which appears to have been overlooked, was made by Bowman[15]. He examined a number of broken wool fibres

and found that they never broke by the severance of the cells themselves but by the cells being pulled out of their sockets. The fact that the wool fibre is perfectly elastic up to the breaking extension is not, therefore, a matter for surprise, since the cell wall need not be extended beyond the elastic limit when the cells are pulled apart, i.e., at the breaking extension.

SUMMARY

The behaviour of a wool fibre under stress is the behaviour of a single cell, which consists essentially of three phases—

(1) The elastic cell wall, enclosing
(2) A fibrillar structure which is not in physical equilibrium with
(3) A viscous phase of gelatinous character included in its interstices.

The new theory is similar to Shorter's in having a three-phase character but its novelty does not consist simply in the identification of the two elastic phases. The hitherto unrecognised fact that the wool fibre has a true yield point, the different mechanism of adaptation to stress and the absence of structural recovery in once-extended fibres, fully illustrate the difference in the two conceptions. Shorter's failure to recognise the absence of structural recovery is due primarily to his working at 68% relative humidity when the gelatinous phase contributes very largely to the strength of the fibre; this phase shows recovery of structure after mechanical disturbance and therefore masks the permanent breakdown of the "elastic elements."

The new theory of the gel structure of the wool fibre has been confirmed by the study of the behaviour of wool fibres under *constant stress*, which will form the subject of a separate paper.

21st April 1926.

Note added 30th June 1926.

Since writing the above, it was suggested to me by Professo J. E. Duerden, M.Sc., Ph.D., that in view of the similarity of structure of muscle and the cells of wool fibres, the former would present a parallel study to that just described. The elastic properties of muscle have been exhaustively studied by Professor A. V. Hill, F.R.S., and in actual fact there is a striking analogy between the two substances, as shown by the following quotation from a paper on "The Dynamics of Muscular Contraction," by H. S. Gasser and A. V. Hill (*Proc. Roy. Soc.*, 1924, 96, B419)—"Let us consider more specifically a cylindrical network, or spongework, of elastic elements permeated with a viscous fluid, such, e.g., as a clot of plasma *formed in a cylindrical elastic tube* (my italics). Imagine that the fibrin elements of the clot adhere to the elastic tubes at their ends, so that they cannot contract to express the serum between them. We have then a system not unlike what we imagine active muscle to be . . . ."

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43—THE EXTENSION OF WOOL FIBRES UNDER CONSTANT STRESS

By John B. Speakman, M.Sc.

(Department of Textile Industries, The University, Leeds).

In a previous paper a new theory of the gel structure of the wool fibre was developed, according to which the behaviour of a fibre under stress is the behaviour of a single cell, which consists essentially of—

(1) An elastic cell wall enclosing

(2) A fibrillar structure which is not in physical equilibrium with

(3) A viscous phase of gelatinous character included in its interstices.

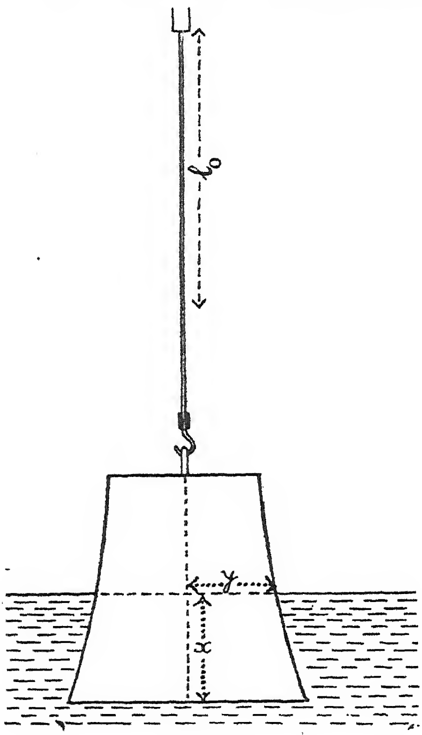

Fig. 1.

This theory was based almost entirely on the study of stress-strain diagrams. Shorter's[1] earlier criticism that, for wool fibres, such diagrams must in reality be stress-strain-*time* diagrams, is no longer valid for those of the previous paper in their entirety, because it was there indicated that the fibre did not show the phenomenon of creep under small stress (below $4{\cdot}0 \times 10^5$ g/cm.^{2}). Below this critical stress the figures are true stress-strain diagrams, but beyond this point they are admittedly stress-strain-time diagrams, since the fibres were not allowed to come to *absolute* equilibrium under any one stress before increasing it. As the second point of inflexion on the curves is of vital importance to the theory it was realised that other evidence, independent of the time factor, must be adduced in support of both. This was obtained by the study of the extension of wool fibres under constant stress, and, in addition, the new method of experiment has indicated a promising method of investigating the nature of the elusive differences between different wools which are usually grouped under the comprehensive term "handle." It has long been felt that this property, so far incapable of accurate scientific measurement, is not simply a function of the different diameters and scale arrangements of different wools, but is due to some inherent difference in the physical nature of the cells of the fibres. The present paper is to some extent concerned with the identification and

measurement of these differences, but the question whether the measured differences are a measure of "handle" must, for the moment, be regarded as indeterminate.

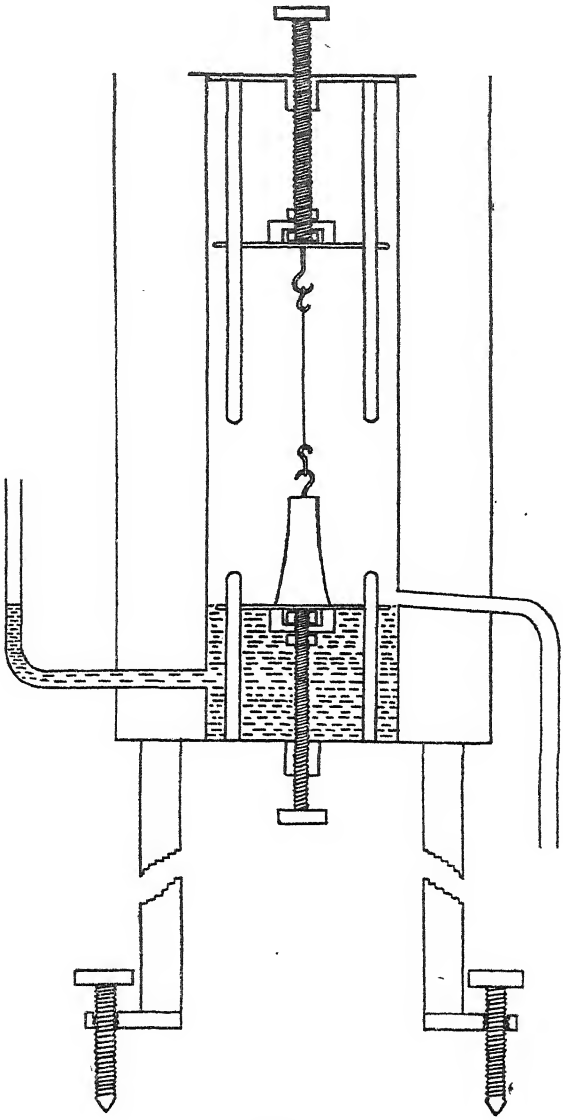

FIG. 2.

Andrade[2] has studied the extension of metal wires under constant stress by means of a method devised by him, which may be called the hyperbolic weight method. "Constant stress was obtained by letting the weight-producing stress sink into a liquid as the wire stretched, the form of the weight being so chosen that the upthrust at any moment was such that the effective load was inversely as the length of the wire at any moment, and thus directly

as the cross-sectional area. The required shape is easily shown to be given by a hyperbola of revolution

$$y=\sqrt{\frac{Ml_0}{p\pi}}\cdot\frac{1}{l_0+x}\cdot$$

where M is the mass of the load, l_0 is the initial length of the wire, and p is the density of the liquid."

The same method has been followed in the present investigation, water always being used as the liquid. Four hollow weights of duralumin, each four centimetres high, were constructed for an initial five centimetre length of fibre in accordance with the above formula. They were adjusted to be accurately 5, 10, 15, and 20 grams weight after turning to the required shape. The apparatus is shown in Fig. 2. A five centimetre length of fibre was attached by means of sealing wax to two glass hooks and its diameter measured at 30 points along its length, the mean diameter being used in computing stress. In the apparatus the upper glass hook was supported by a brass hook as shown, the lower hook engaging the hook of the weight which rested on a horizontal platform adjusted level with the surface of the water. The fibre was pulled just taut by a turn of the upper brass screw and its exact length measured *in situ* by means of a reading microscope sensitive to 0·05 mm. Release of the load was effected by screwing down the platform. It will be seen from the figures to be communicated later in the paper that the immediate extension of the fibre is very high, even under stresses far removed from the breaking stress. In consequence, the application of stress in these experiments was never instantaneous but occupied times up to 30 seconds. This is a difficulty which can hardly be overcome, as it would be fatal simply to drop the platform instantaneously; the fibre would then be subjected to an indeterminate stress on account of the kinetic energy of fall of the weight. A compromise was effected by lowering the platform at a constant rate, the water level being kept constant by the overflow pipe. Temperature control was maintained by the outer water (or ice) jacket.

EXPERIMENTAL

Immediate Extension on Application of Stress

Andrade has shown that the rate of extension of metal wires under constant stress can be expressed by a formula of the type—

$$l = l_0(1+\beta t^{1/3})e^{kt}$$

where β and k are constants and t is the time after application of stress. l_0 is not the initial length of the wire but a somewhat larger quantity, considered to be the length immediately on loading. It is obvious that if the same equation expresses the rate of extension of wool fibres under constant stress, the values of l_0 give at once a measure of the immediate extension of fibres on loading. Such data are free from criticism on the ground that wool shows the phenomenon of "elastische Nachwirkung." In Table 1 below are given the experimental values of the extension of two typical fibres under constant stress in saturated air at 15° C. It was found that the values of k were so small that up to about 100 minutes' time the values of e^{kt} could be neglected; the calculated values of the extension were therefore obtained by the use of the simple formula—$l=l_0\ (1+\beta t^{1/3})$.

TABLE I.

1—Cotswold Fibre

Diameter $=0\cdot00473\pm0\cdot00022$ cms. Initial length $=4\cdot925$ cms.
Stress $=8\cdot54\times10^5$ g/cm.^{2} $l=6\cdot322\ (1+0\cdot00857t^{1/3})$.

Time in Minutes		Calcd. Extn. (cms.)		Obsvd. Extn. (cms.)
1·55	...	(1·459)	...	1·460
3	...	1·475	...	1·490
5	...	1·488	...	1·510
10	...	1·512	...	1·530
15	...	1·529	...	1·540
30	...	1·564	...	1·570
45	...	1·588	...	1·590
62	...	1·611	...	1·610
90	...	(1·639)	...	1·640
120	...	1·664	...	1·660
158	...	1·688	...	1·680
283	...	1·751	...	1·755
390	...	1·791	...	1·805

2—Cotswold Fibre

Diameter $=0\cdot00400\pm0\cdot00022$ cms. Initial length $=5\cdot015$ cms.
Stress $=11\cdot93\times10^5$ g/cm^2. $l=6\cdot655\ (1+0\cdot01069t^{1/3})$.

Time in Minutes		Calcd. Extn. (cms.)		Obsvd. Extn. (cms.)
1	...	(1·710)	...	1·710
2	...	1·729	...	1·740
5	...	1·760	...	1·780
10	...	1·793	...	1·810
21	...	1·835	...	1·845
42	...	1·886	...	1·890
115	...	(1·985)	...	1·985
217	...	2·066	...	2·085

The agreement between calculated and experimental values of extension is reasonably accurate, especially in view of the somewhat irregular diameter of the fibres. Andrade's formula has therefore been employed as a convenient method of extrapolation to find the instantaneous extension of wool fibres under stress.

Three kinds of wool were examined—English Cotswold, Australian Leicester, and Australian Merino—and the values of the immediate extension in saturated air at 15° C. are given in Table II.

TABLE II.

Kind of Wool	Stress (g/cm^2.)		Immediate Percentage Extension
Cotswold	$5\cdot05\times10^5$	...	2·64
	5·38	...	9·13
	6·14	...	13·2
	6·95	...	18·6
	7·02	...	19·5
	8·54	...	28·4
	10·04	...	30·1
	10·16	...	29·6
	11·93	...	32·7
	13·11	...	34·7
	14·92	...	35·0
Australian Leicester	5·79	...	8·69
	8·10	...	26·2
	10·78	...	32·0
	14·15	...	35·8
	15·96	...	36·8
Australian Merino...	8·86	...	29·7
	15·14	...	36·8

The graph of these results (Fig. 3) is extremely significant. In the first place, the immediate extension of wool fibres under stress is seen to be independent of the nature of the wool; in spite of the extreme contrast between Cotswold and Merino wools, the results for each lie on a common curve. This seems to indicate a surprising uniformity of character of the fibrillar structure within the fibre cells of different wools. Further, the graph falls into two distinct straight line portions, the first of which would *not*

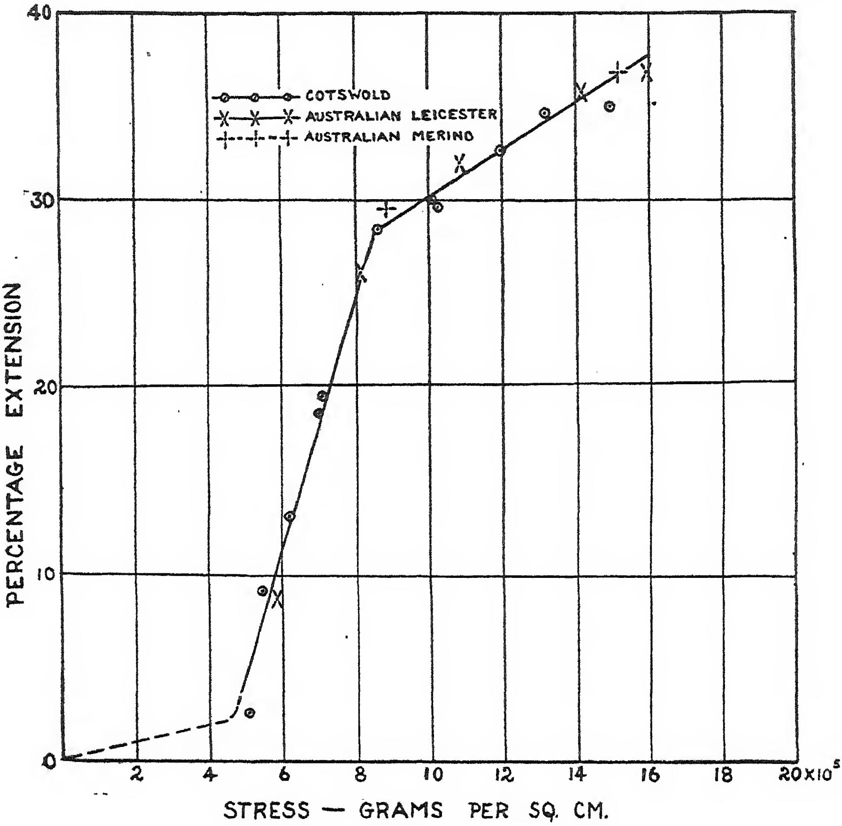

FIG. 3.

pass through the origin on extrapolation. This is conclusive confirmation of the fact recorded in the previous paper, that wool has a definite yield point in the neighbourhood of $4{\cdot}0 \times 10^5$ g/cm.[2] The previously discovered Hooke's Law portion of the stress-strain diagram has therefore been dotted in to complete the graph. The type of the complete curve is exactly similar to the previously described stress-strain diagrams in possessing two points of inflexion, the existence of which must therefore be regarded as independent of the rate of loading. As before, the first point of inflexion is regarded as a true yield point due to the breakdown of the fibrillar structure within the cells, while the second is due to the retardation of slip of detached fibrillæ on account of the tightening of the cell wall on its contents. The fact that the extension-stress curve is composed of two straight lines (after the yield point) is additional reason for supposing that Poole's[3] theory of fibrillar rotation cannot apply to wool.

The preceding observations afford no measure of the differences between wools. These reveal themselves on studying the *rate* of extension of different fibres under constant stress.

Rate of Extension under Constant Stress

Data illustrating the rates of extension of different wool fibres under constant stress in saturated air at 15° C. are given in Table III.

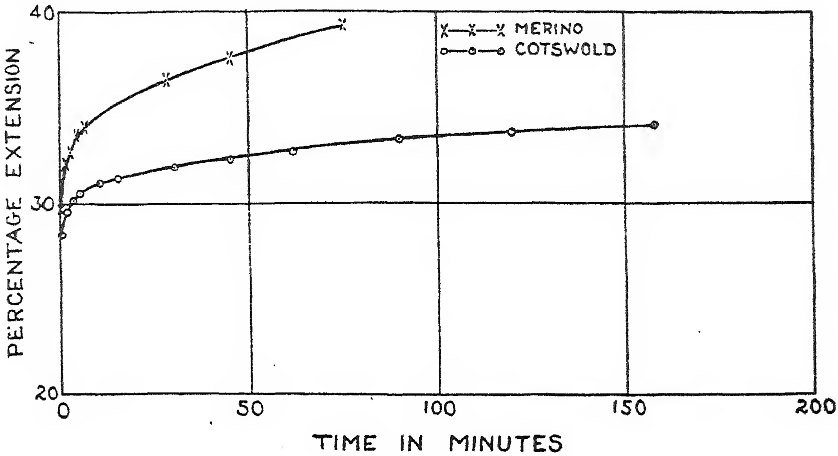

FIG. 4.

TABLE III.

Cotswold Fibre Stress = $8{\cdot}54 \times 10^5$ g/cm². Time (minutes)		Cotswold % Extension	Merino Fibre Stress = $8{\cdot}86 \times 10^5$ g/cm². Time (minutes)		Merino % Extension
0	...	(28·4)	0	...	(29·7)
1·55	...	29·6	1·167	...	32·1
3	...	30·2	2	...	32·7
5	...	30·6	4	...	33·6
10	...	31·1	6	...	34·0
15	...	31·3	28	...	36·4
30	...	31·9	45	...	37·6
45	...	32·3	75	...	39·2
62	...	32·7			
90	...	33·3			
120	...	33·7			
158	...	34·1			

Although the stress is in each case essentially the same, the rate of extension of Merino wool is far higher than that of Cotswold wool, and the two curves (Fig. 4) give a *qualitative* indication of the difference between the two wools. According to the new theory of fibre elasticity the slow extension of wool fibres under stress is due to the slip of fibrillæ in a viscous medium, and in order to give quantitative expression to the observed differences, it is essential to have a measure of its viscosity. This is afforded by the constant β in Andrade's equation. For metal wires it was considered to be a measure of the rate of rearrangement or rotation of crystals in a viscous matrix. In the parallel case of wool fibres it will, by analogy, express the rate of rearrangement of fibrillæ in a gelatinous medium. β will therefore vary inversely with the viscosity of the latter. The term "viscosity" is used with some

reluctance and must be interpreted in the widest possible sense, in view of the fact that capillary phenomena, and not the properties of fluids in bulk, are being considered.

β is also a function of stress as shown by the figures of Table 4. These were evaluated from data for the rate of extension of fibres at 15° C. in saturated air.

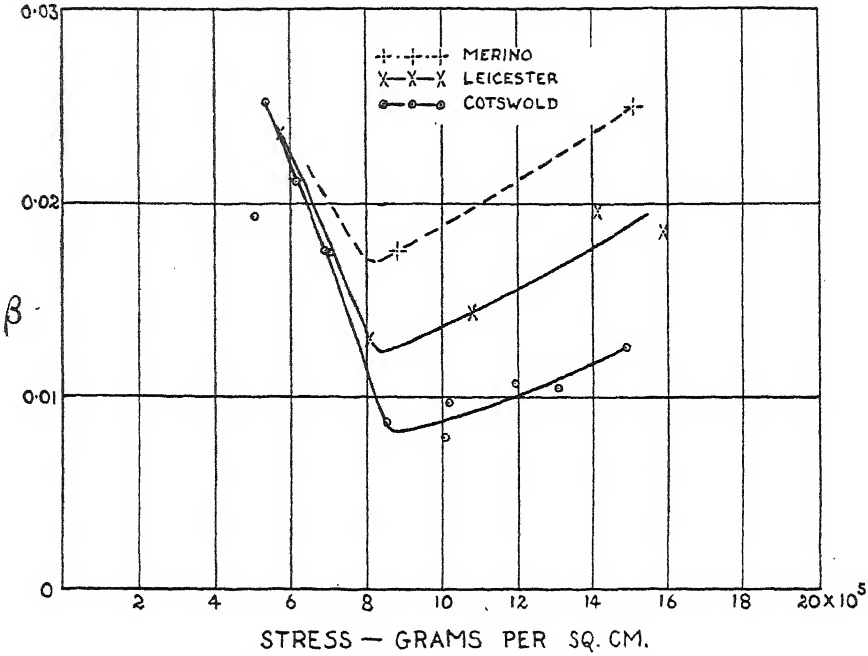

FIG. 5.

TABLE IV.

Kind of Wool	Stress (g/cm²)		β
Cotswold	5·05 × 10⁵	...	0·0193
	5·38	...	0·0252
	6·14	...	0·0211
	6·95	...	0·0176
	7·02	...	0·0175
	8·54	...	0·0086
	10·04	...	0·0078
	10·16	...	0·0096
	11·93	...	0·0107
	13·11	...	0·0104
	14·92	...	0·0125
Australian Leicester	5·79	...	0·0236
	8·10	...	0·0129
	10·78	...	0·0143
	14·15	...	0·0195
	15·96	...	0·0184
Australian Merino...	8·86	...	0·0175
	15·14	...	0·0250

The β/stress curve for Cotswold wool is complete (Fig. 5) and has a sharp inflexion at the same stress as the extension/stress curve (Fig. 3). The

explanation of the v-shaped curve, which must be contrasted with the corresponding sigmoid curve for metal wires, is complicated because β is a function of three variables—

(1) The number of detached fibrillæ,

(2) Their rate of slip, and

(3) The immediate extension.

The number of detached fibrillæ increases continuously with stress so that β should be a direct function of stress. This is not so because, assuming a definite amount of slip to be possible under a given stress, this may occur either in the immediate extension or in the subsequent slow creep, or both. If the majority of the possible slip occurs in the immediate extension, β will be small, and *vice versa*. At the yield point β is a maximum because the breakdown of the structure is high and the immediate extension small. With increasing stress, more of the possible slip occurs in the immediate extension, and β decreases until, at a certain critical stress ($8{\cdot}5 \times 10^5$ g/cm.^{2}) the immediate extension is retarded. Thereafter β increases because the number of detached fibrillæ increases although the rate of slip of each is reduced. The interdependence of β and the immediate extension is well shown in the subsequent discussion of the rates of extension of wool fibres after exposure to ice temperature for three hours.

There is a sharp differentiation between the values of β for the different wools especially above the critical stress already defined. In order of decreasing values of β we have Merino > Leicester > Cotswold. It is significant that this is precisely the order in which the wools would be placed from considerations of "handle." It seems probable that decreasing viscosity of the viscous phase should promote suppleness of the fibre, and this must at least be a contributory cause of the pleasing "handle" of some wools.

A promising method of studying and elucidating the different physical characteristics of different wools is thus opened up, and a collection of wools of known origin and pedigree is being made for the continuation of the experiments.

The Gelatinous Character of the Viscous Medium

The gelatinous character of the viscous medium was confirmed by the extension of fibres under constant stress at 0° C. in saturated air. If the medium is gelatinous, its fibrillar structure must increase in complexity when the temperature is reduced and the magnitude of the increase will depend on the time of exposure to low temperature. When this time is high, and the complexity great, the viscous phase should impede very markedly the immediate extension on applying stress. Even when the time of exposure is small, the increased viscosity of the medium should reveal itself in a reduced value of the constant β. These deductions have all been experimentally realised.

The effect of long exposure to low temperature is well shown by the curves of Fig. 6. The upper curve was obtained by extending a wool fibre in saturated air at 15° C. under a stress of $8{\cdot}54$ by 10^5 g/cm^2, while the lower curve is true for a fibre from the same sample of wool (Cotswold) extended under a stress of $8{\cdot}08$ by 10^5 g/cm.^{2} in saturated air at 0° C., after three hours' exposure to that temperature. The immediate extension in the latter case was only $19{\cdot}1\%$ compared with $26{\cdot}2\%$ at 15° C. under the *same* stress. In

three hours' exposure to ice temperature, therefore, the viscous phase developed a sufficiently strong fibrillar structure to impede even the immediate extension under stress. The initial *rate* of extension at 0° C. was, however, far higher than at 15° C., the value of β in the former case being 0·0161 compared with 0·0102 in the latter. The higher value of β at 0° C. is deceptive and is due primarily to the lower initial extension at that temperature, for if β at 0° C. is compared with β at 15° C. for the *same initial*

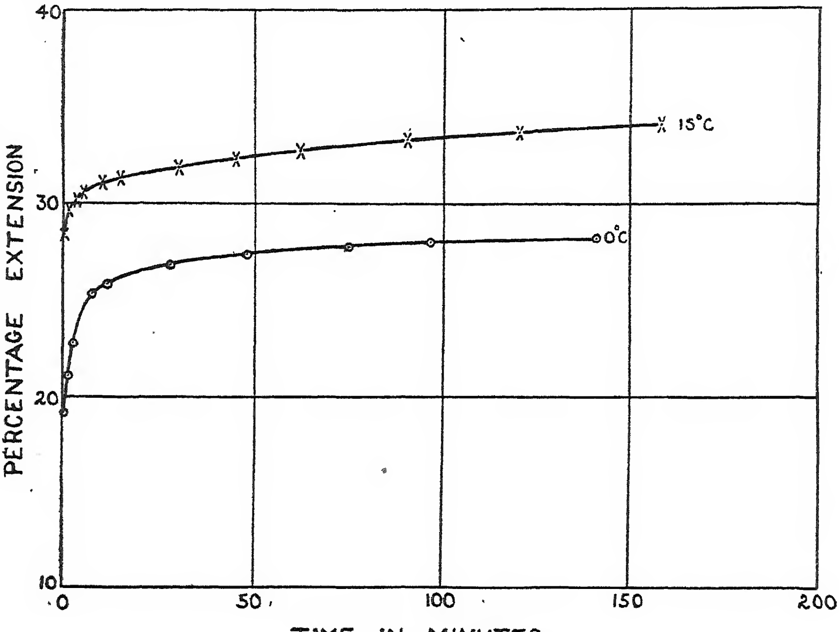

FIG. 6.

extension but *smaller stress* the two values are almost identical—0·0161 and 0·0163 respectively. In reality, therefore, the rate of slip of single fibrillæ at 0° C. is less than at 15° C. under the *same* stress.

The behaviour of wool fibres under stress after exposure to ice temperature for 45 minutes only, is very different from that described above. The immediate extension under stress is practically the same as at 15° C. but the rate of flow is completely changed as well as the form of the β/stress curve. Under these conditions, β appears to change very little with stress as shown by the following figures.

TABLE V

Stress g/cm².	β
$4{\cdot}60 \times 10^5$	0·0069
8·73	0·0072
12·58	0·0080
16·62	0·0076

Cotswold wool was employed and it is evident from the figures that at 0° C. β is always less than at 15° C., indicating an increased viscosity of the medium. It is fortunate that the immediate extension under stress is the same at the two temperatures or, as already indicated, it would be difficult to compare the values of the constant under the different conditions.

The preceding observations all lend support to the view expressed in the previous paper that the viscous medium is gelatinous and develops a well-marked fibrillar structure at 0° C. It was there suggested that the viscous phase probably sets to a gel at, or above, 0° C. and as the present observations have indicated a difference in the nature of the phase from one wool to another, it becomes of importance to determine the setting points of this phase in different wools. This work is being undertaken in conjunction with that already specified. Further, it is believed that the behaviour of different wools under different humidity conditions will give valuable information concerning the nature of the phase, and with a view to conducting such experiments the present apparatus is being modified and a new set of weights suitable for use with oil, in place of water, constructed.

SUMMARY

The present investigation has confirmed the views expressed in a previous paper concerning the gel structure of the wool fibre. The existence of a definite yield point has been demonstrated and the occurrence of a second point of inflexion on the stress-strain diagram for wool shown to be independent of the rate of loading.

Andrade's expression for the rate of extension of metal wires under constant stress has been shown to apply equally well to wool fibres, and data have been given enabling one to calculate the extension and rate of extension of English Cotswold wool at 15° C. in saturated air under any stress.

Finally, the existence of a gelatinous phase in the wool fibre has been confirmed. It has been shown to vary in composition from one wool to another and to change in viscosity with temperature.

The investigations are being continued on the lines suggested.

21st April 1926

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[1] Shorter, J. Text. Inst., 1924, **15**, T207.
[2] Andrade, Proc. Roy. Soc., 1910, **84A**, 1.
[3] Poole, Trans. Far. Soc., 1925, **21**, Part 1, p. 114.

44—THE LEVELNESS OF MULE YARNS

By A. E. Oxley, M.A., D.Sc., F.Inst.P.
(The British Cotton Industry Research Association)

Although the reply of S. G. Barker (*J. Text. Inst.*, August, T435) to my criticism, (July, T369) of his paper, "A Gravimetric Method for Investigation of the Variation and Levelness of Yarn" (June, T259) shows that he does consider twist to be a vital factor in determining the levelness of yarns, he still, however, ignores the real point, which is obviously the basis of my criticism, viz., the incorrectness of his statement (June, T263) that "in the case of cotton Oxley found a maximum thickness at the end of each draw, or approx. 70 in. apart." Following upon this misstatement of my results, my subsequent remarks were perfectly justifiable and were purposely confined to cotton yarns to elucidate the incorrectness of the above quotation and to correct a wrong interpretation of results obtained four years ago.

Further, the fact that Barker now admits that the *application* of the gravimetric method to woollen yarns and not the method itself is his claim, can hardly be reconciled with the claim made in his paper (June, T260), viz., "(*a*) Indicating a new method for determination of variations in yarns."

Shirley Institute,
Didsbury, *2nd September* 1926.

Reply to above letter by S. G. Barker, Ph.D., D.I.C.

(The British Research Association for the Woollen and Worsted Industries)

By the courtesy of the Editor I have been allowed to see Dr. Oxley's further note. Since Oxley has clearly emphasised that his work refers to cotton, I equally emphasise that mine refers to wool. In my first reply I have completely explained and justified my position in the matter, and I feel that further comment is unnecessary.

Torridon, Headingley,
Leeds, *8th September* 1926.

45—COLOUR PROBLEMS IN THE WOOLLEN AND WORSTED INDUSTRIES

By S. G. Barker, Ph.D., D.I.C., and H. R. Hirst, B.Sc., F.I.C.

(British Research Association for the Woollen and Worsted Industries, Leeds.)

Paper Presented to the British Optical Convention, London, April 1926

The decorative value of textile materials of all kinds is one of the most important factors in their production. Strength and durability are highly essential in a fabric, but the property most readily observed and which contributes most to the æsthetic sense is its colour or coloured pattern. This is, therefore, of commercial importance. The object of this paper is to survey the present position from physical, chemical, technical, and trade points of view, and to embody results of practical work in the laboratories of the British Research Association for the Woollen and Worsted Industries, Leeds. The immediate problems to be faced are manifold, but there seems to be no doubt that three main questions present themselves initially.

(1) The choice of standard illumination.
(2) The fastness and durability of a colour to the influence of external conditions.
(3) The determination of the exact shade of a colour, and its numerical representation.

Under heading (2) we may first consider what these external influences might be. Firstly, we have chemical action. The effects of alkalis and acids and such natural causes as perspiration, &c., are readily estimated by chemical methods and analysis. Secondly, we have physical influences. Humidity, temperature, light, friction, &c., under our daily atmospheric conditions. The methods of estimating the action of these quantities can only be said to be in a very unsatisfactory condition.

There is no international standard method for expressing the fastness of various colours to a standard source of light. The usual method in dye-houses is to expose dyed patterns along with certain well-known dyes to sunlight, either in a clear atmosphere or in the atmosphere near the factory, and for colours for use in the tropics, patterns are sent out for exposure. Hence there arises an ambiguous position in which fading is sometimes expressed as fastness to sun and air, and at other times as fastness to sun and air and chemicals.

First and foremost in the difficulties experienced, is the fact that no standard source of daylight is available for comparative tests to be made. It is obvious that this standard source of light should approximate in properties, as closely to daylight as possible. Let us first enumerate the properties required in such a light. The light must be reproducible and constant over long periods, both as to quality and quantity of light. It should produce the same changes in dyed material as sunlight would effect if the material were exposed in actual use. Sunlight itself is very slow in action and very variable both in quantity and quality. Some idea of the variation

of intensity of sunlight is given by curves due to Dr. H. B. Gordon (Fig. 1), giving the results of tests made in Arizona and New Jersey. To quote from his paper, "The fading action to dyestuffs of New Jersey summer sun, was on the average four or five times as rapid as that of Arizona winter sun." The curves shown here show the variation in intensity of sunlight throughout the year in New Jersey. P. R. Ord (Messrs. Adam Hilger, Ltd.) has

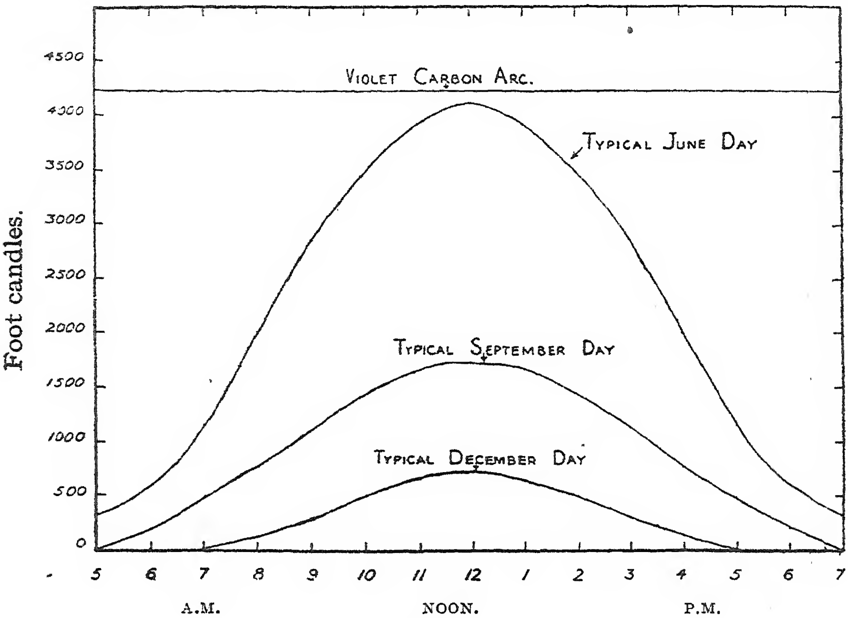


Fig. 1
Variation in the intensity of sunlight with time of day and season of the year.

shown, as a result of spectro-photometric experiments on the relative variations of "red," "green," and "blue" energy in the spectrum of north sky light, that the ratio of green to red varied between 31% and −25% on various days, while the corresponding variation of blue to red was between 45% and −25%.

The limits of the solar spectrum are influenced by the seasons, by the height of the sun above the horizon, i.e., the time of day and latitude, by the altitude and by the atmospheric conditions prevailing. The spectral range decreases very considerably the lower the sun is in the heavens, i.e., with the longer path through the earth's atmosphere that the radiation has to traverse. The range in the N. hemisphere is at a maximum in July, whilst in winter the smallest amount of ultra-violet radiation is present. In winter the amount of ultra-violet radiation at high altitudes varies considerably from that found at low ones, the greatest amount of both calorific and ultra-violet radiation being at the higher points. With the exception of July the intensity of the calorific radiations is always greater than that of the ultra-violet. It is thus seen that the extreme variation of sunlight itself coupled also with its slow action, renders it undesirable as a source of light for comparative fading tests. An artificial source of light is therefore sought and one with approximately the same energy distribution as summer sun at sea level is required. In this regard many workers have investigated the

various sources of light, but there seems to be no unanimity as yet as to the precise energy distribution of a standard source or its method of production.

In 1901 Lummer and Pringsheim completed their experimental examination of the distribution of energy of a "black body" radiator at various temperatures and found that the total energy increases very rapidly for all wave lengths with increase of temperature and also that the maximum moves towards shorter wave lengths. The energy fall towards this region is more rapid as visibility is approached. In practice, artificial sources of light consist of some body raised to a state of incandescence and consequently a large proportion of the energy is emitted as heat and does not affect the light sensation at all.

We should, therefore, expect the maximum energy of the spectrum in such cases to be well away in the infra red. The problem was attacked by Wien, and in 1896 he put forward on thermodynamical principles, the formula—

$$E_\lambda = C_1 \lambda^{-5}\, e^{-\frac{C_2}{\lambda T}}$$

where C_1 and C_2 are constants, λ the wave length in terms of μ, and T the absolute temperature. This fitted in with experimental results for short wave lengths, but in 1900 Planck put forward an amended expression—

$$E_\lambda = C_1 \lambda^{-5} \left(e^{\frac{C_2}{\lambda T}} - 1\right)^{-1}$$

T for the sun is approximately 5,000° abs. Taking into consideration the limits of experimental error, &c., we conclude that for practical work on energy distribution Wien's law is sufficiently accurate when dealing with the visible spectrum.

Langley investigated the infra-red portion of the spectrum with the bolometer and Abbott continued on similar lines. Priest examined the data thus obtained for the energy distribution in the visible spectrum and a curve for mean energy distribution for noon sunlight was the outcome. This curve shows that such sunlight closely, though not strictly, resembles the radiation of a black body of temperature 5,000° to 5,300° absolute. The maximum energy occurred at a wave-length of 0·59 μ.

Nichols has compared the radiation from the sky under varying conditions with that of a standard acetylene flame. The energy distribution of such a flame has been fully investigated by Coblentz and the results of his work appear in the Bureau of Standards reports, the most important being No. 362, Scientific Papers of the Bureau of Standards, 12th Feb. 1920. The values of sky radiation are easily deduced from Nichol's results. Various other workers have also contributed to the solution of the problem.

Several energy distribution curves, for which we are indebted to Dr. L. C. Martin (Cantor Lectures, 1924), are shown in the accompanying diagram (Fig. 2) and show the energy distribution curves for blue sky, high and low sun, black body at 5,000° abs., gas-filled electric lamp, and a standard acetylene flame. Nichol's values, as obtained above, show daylight to be a very variable quantity. The scattering effect of fog, mist, or dust causes the energy distribution to fall more nearly approximate to those of artificial light, owing to the elimination by scattering of the shorter wave lengths. In 1910 Ives suggested that standard daylight should be the radiation of a black body at 5,000° abs. H. P. Gage (Sibley, *Journal of Engineering*,

No. 8, May 1916) suggested that an average "daylight" should be a compromise between blue sky light and sunlight and such as would be given (in accordance with Planck's law) by a black body of temperature 6,500°–7,000°. This approximates to the north light desired by artists and is also recommended by Dr. L. C. Martin. Incidentally it may be mentioned that the results of fading experiments made by us show that north light fading is of the same quality as south light fading, but it is not so rapid in action.

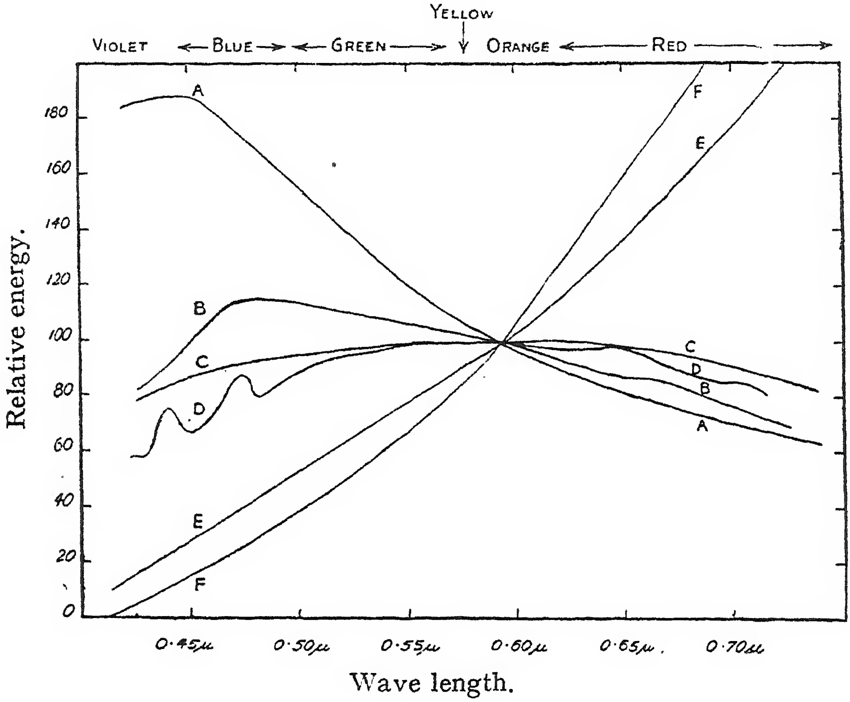


FIG. 2

Energy distribution in the spectra of various illuminants

A—Blue sky.
B—High sun (data from the Smithsonian Institute).
C—Ives' suggested standard (black body at 5000° C.).
D—Low sun (Smithsonian)
E—Gas-filled tungsten lamp.
F—Acetylene flame.

If such a standard could be fixed, then the work of finding a suitable daylight lamp would be definite, for a close approximation to the same energy distribution would be aimed at. Since energy distribution is such an important factor in these investigations a brief note may be given on a method of comparison recently adopted by the authors for comparing the energy distribution of various sources of artificial light.

Nicholson and Merton established a method for the measurement of the photographic intensities of the lines of the helium spectrum, wherein it is shown that the photographic intensity due to a particular wave length can be measured by using a wedge of neutral glass. The apparatus and method used by us is essentially the same as that of Nicholson and Merton and consists of a spectrograph, in front of the slit of which is mounted a neutral-tinted glass wedge, cemented to a similar wedge of colourless glass so as to form a plane-parallel plate. The spectra of the various sources of light

were photographed through the neutral wedge, and the resulting photographs consist of continuous spectra which are dark along the edge corresponding to the thin edge of the wedge and which fade away towards the region corresponding to the dense end. Thus the height of the spectrum on the plate at any particular wave length corresponds to its intensity and it is essential that an accurate determination of the height of the curve at all points be made. A ruled process screen is utilised for this purpose as in Nicholson and Merton's experiments. The negative obtained from the spectrograph is reversed by printing on to a plate covered with lantern slide emulsion, and carefully developed. The process screen is placed in contact with the film side of the lantern plate and then both are placed in an enlarger. The enlarged print (about four times the original) provides an enlarged reproduction of the original negative in which the spectrum photograph is made up of minute dots about one 100th of an inch apart. The limits of the spectrum can now be pricked out right across the record by observing the last visible dot when seen through an ordinary magnifying glass. The points so obtained can be joined by a fine line and thus the intensity curve is obtained. In order to calibrate the plate, a spectrum of the carbon arc is taken upon a different portion of it for each negative. The helium spectrum is also added below each exposure for purposes of identification and calibration of the spectrum. As a preliminary, of course, a precise knowledge of the constants relating to the wedge must be obtained.

Theoretical Discussion

The wedge of neutral glass shows no absorption of a selective character, but there is an increase of absorbing power with decreasing wave length. If light of incident intensity I_i falls on such a wedge at any point and I_t is the intensity transmitted, the density at that point of the wedge is defined as

$$-\log_{10} \frac{I_i}{I_t}$$

Let P_λ be the "coefficient" of extinction of the glass for light of wave length λ. It is such that if the incident intensity be I_1 and the transmitted intensity passing through a thickness y of glass be I_2, then $I_2 = I_1 e^{-yP_\lambda}$

If α be the angle of the wedge and x is the distance of any point along it from the thin end, then $y = x \tan \alpha$ or for the whole wedge of length l the intensity ratio is—

$$\frac{I_2}{I_1} = e^{-P_\lambda\, l \tan \alpha}$$

This is the ratio of transmitted light at its ends for the same incident intensity. An expression called by Nicholson and Merton *the "density"* of the wedge, is therefore given by—

$$-\log_{10} \frac{I_1}{I_2} \text{ or } l \tan \alpha P_\lambda$$

and this is denoted by D_λ for a particular wave length λ.

Now if l_λ be the height of the spectrum before enlargement and h_λ its visible height after enlargement and if l and H be the corresponding quantities for the whole length of the wedge $\frac{h_\lambda}{H} = \frac{l_\lambda}{l}$ since the magnification is the same in both cases, or $h\lambda = \frac{l_\lambda H}{l}$.................(A)

Let I_c be the intensity at which a point of the spectrum corresponding to a particular wave length (λ) is first visible. Then if I_λ be its original photographic intensity and if a thickness l_λ of the wedge reduce its intensity to I_c we have

$$\frac{I_c}{I_\lambda} = 10^{-P_\lambda l_\lambda \tan \alpha} \quad \text{or} \quad \log_{10} \frac{I_\lambda}{I_c} = P_\lambda l_\lambda \tan \alpha$$

or substituting from (A) above

$$\log_{10} \frac{I_\lambda}{I_c} = \frac{P_\lambda l h_\lambda}{H} \tan \alpha = \frac{D_\lambda h_\lambda}{H}$$

Thus we get $\dfrac{I_\lambda}{I_c} = \text{Antilog} \dfrac{(D_\lambda h_\lambda)}{H}$.

This expression gives the photographic intensity of the original wave length λ.

For a comparison of the relative photographic intensities of different wave lengths throughout the spectrum we do not need the actual knowledge of I_c.

The photographic intensity of wave length λ is therefore defined as Antilog $\left(\dfrac{D_\lambda h_\lambda}{H}\right)$

The density gradient of the wedge was determined by the use of Nicol prisms as is given by Nicholson and Merton, and the value of D was determined throughout the spectrum and a curve drawn. The reduction of photographic to absolute intensities necessitates the use of a photographic record of some standard source of radiation extending over the whole region of wave length examined. As a standard of radiation the positive crater of the carbon arc burning in air at atmospheric pressure was adopted and the assumption made that the distribution of energy in this source is that of a black body at the temperature of vaporisation of carbon. A difficulty found by Nicholson and Merton which restricted the accuracy of the method was the exact definition of the temperature of the arc actually used. In order to verify our work further the arc was compared with a standard acetylene flame such as is already mentioned in this paper, the distribution in which was fully investigated by Coblentz. The acetylene flame is convenient and easy to use.

Assuming Wien's Law for a black body, a measure of the intensity for a given wave length λ is given by

$$\lambda^{-5}\, e^{-\frac{a}{\lambda T}}$$

a is given by Kaye and Laby as 1·4 and T was taken as 3,750° C. absolute for the carbon arc as given by Dr. Harker of the N.P.L. with λ in centimetres

$$I = \lambda^{-5}\, e^{-\frac{a}{\lambda T}}$$

and this value can be worked out for all wave lengths throughout the spectrum.

These intensities can now be expressed as a ratio of the intensity of any one wave length taken arbitrarily, this wave length being ascribed an intensity value of unity. We thus have a method by which we can work out the absolute intensity of the various wave lengths of the spectrum of the source under test. It is shown by Nicholson and Merton that absolute intensity of a source for a particular wave length λ

$$= \frac{\text{Photographic intensity of source for } \lambda}{\text{Photographic intensity of arc for } \lambda} \times \text{Absolute intensity of arc.......(B)}$$

The photographic intensities are known from the formula

$$\frac{I_\lambda}{I_c} = 10^{\frac{D_\lambda h_\lambda}{H}} \quad \text{.........................(C)}$$

which can be worked out for each wave length of the spectra recorded on the plate as shown above.

For any particular wave length the critical intensity I_c affecting the plate (which is a function of the wave length) may be treated as constant, as also may D_λ. It is, therefore, obvious that in the determination of absolute intensity of a source for a particular wave length the quantity I_c

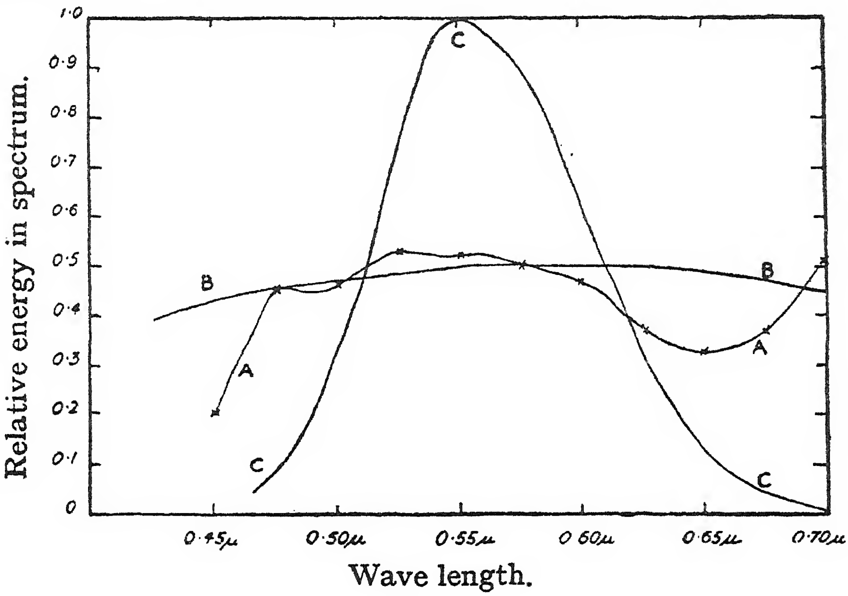


FIG. 5

A—Energy distribution in spectrum of a particular artificial daylight lamp.
B—Energy distribution mean sunlight.
C—Visibility curve.

is eliminated by division on taking the ratio of the photographic intensity of the source, to that of the carbon arc for the same wave length. Thus if $\frac{I_\lambda}{I_c}$ represent the photographic intensity for the source under test and $\frac{I^1_\lambda}{I_c}$ the same quantity for the carbon arc, whilst h_λ and h^1_λ represent the heights of the enlarged spectrum record taken through the wedge as indicated previously for a particular wave length, H and D_λ being constant we have from formula (C)—

$$\frac{I_\lambda}{I_c} = 10^{\frac{D_\lambda h_\lambda}{H}}$$

and

$$\frac{I^1_\lambda}{I_c} = 10^{\frac{D_\lambda h_\lambda}{H}}$$

Therefore taking ratios of photographic intensities

$$\frac{I_\lambda}{I^1_\lambda} = \frac{10^{\frac{D_\lambda h_\lambda}{H}}}{10^{\frac{D_\lambda h^1_\lambda}{H}}} = 10^{\frac{D_\lambda}{H}(h_\lambda - h^1_\lambda}$$

The ratio of the photographic intensities can thus be determined since D_λ, H, h_λ, and $h^1{}_\lambda$ are all known and thus formula (B) can now be worked out and absolute intensities found.

In this way the distribution of energy throughout the spectrum of any particular source can be measured and for black body radiators, as shown by Plaskett, Griffiths, and Harris, the temperature of the source can be found if required. This method is being applied by us to the problem now before us of determination of energy distributions for sources of light for artificial daylight fading experiments. Figs. 3 and 4 show some typical records.

In the course of the work, the effect of placing various screens between the source of light under test and the spectrograph was noted. A ground glass screen considerably altered the curve of energy distribution and ordinary glass gave a considerable modification. This shows that for fading tests it is essential that the material of the enclosing globe should transmit all radiation as far as possible. Fused quartz or Vitaglass are excellent for this purpose, but the devitrification of the former and the heat resisting properties of the latter give great disadvantages in their use.

Light radiations can be modified by transmission through or reflection from certain material substances and such modifications arise frequently by reason of selective absorption of some of the wave length components of the original beam. So long as the work is restricted to the visible spectrum, these screens and reflectors are of great use in simulating daylight, but for fading tests there is a loss of intensity and frequently a removal of the shorter wave lengths which is unavoidable.

The simple nature of the curves obtained for the energy distribution of various sources shows that there is no very complicated nature for the properties of a light filter necessary for the correction of the excessive energy of the longer wave lengths and, knowing the energy distribution in the particular source, the required densities or transmission coefficients for the filter can easily be calculated. The full discussion of light filters is unnecessary here as the literature is well known, but we would welcome any co-operation in this matter if there is a possibility of devising a standard fading source by the employment of such filters. Dr. Martin (Cantor Lectures) gives a comparison of the energy distribution of the spectrum of a typical daylight lamp and that of sunlight. It is seen from these that there is an excess of energy at the extreme red end of the spectrum and a deficiency in the extreme violet, and whilst in these regions visibility is low, so that the eye cannot perceive the discrepancy in colour matching, yet for standard fading experiments these radiations are all important and the lamp is thus rendered unsuitable.

Further, experience has shown that it is these radiations beyond the visible spectrum which are extremely powerful in effecting colour deterioration. Certain dyestuffs—known as sensitive tints and dealt with later—show different shades when illuminated by light from different sources and this phenomenon is due to the strong absorption of the central portions of the visible spectrum and the consequent variation of shade and colour when there is variation at the extreme ends. It would, therefore, seem that one must attempt the production of a source of light which would reproduce daylight or sunlight as nearly as possible without filters and then possibly correct these by filtration or reflection to a limited extent, the objection to the

latter process being stated above. Thanks chiefly to the therapeutic qualities of sunlight, attention has recently been focussed on this matter. By the kindness of Messrs. Cox Cavendish Electric Co. Ltd., we have been able to secure a reproduction of the spectra of various illuminants, and from an American source we have also obtained details of the spectrum of the violet carbon arc. (Figs. 6 and 7.) Our results show how these sources fit in with true requirements. The latter is certainly amongst the best obtainable for the purpose of fading tests, but our results show that they are really little criterion as to what actually happens in sunlight under varying atmospheric conditions.

The tungsten carbon arc is being investigated as a possible source of illumination for fading experiments. It is extremely rich in the ultra-violet, but careful scientific work has yet to be done on it before a definite decision can be made.

In a recent paper by Hermann (*Chem. Zeit.*, 1924, p. 813) it is shown that sunlight consists of vibrations of light of 2,000 to 40,000 Å.U. and is particularly rich in 8,000 to 40,000 Å.U., and only contains 1% of 2,000 to 3,000 Å.U. The mercury vapour lamp has been suggested as a possible standard source, but it yields 25 to 30% ultra-violet light and visible light of only 4,000 to 6,000 Å.U.

Hermann divides dyes into four categories expressed as follows—

Category 1—Colours destroyed by short wave length = Microtrope system.
2—Colours destroyed by long wave length = Macrotrope system, e.g., Auramine.
3—Colours destroyed by short and long wave lengths = Homotrope system.
4—Colours destroyed by longer ultra-violet wave lengths have more effect than the shorter wave lengths, i.e., 3,000–4,000 Å better than 2,000–3,000 Å = Mesotrope system.

Examination of the eight norms of the German Commission on colour fastness for wool, three were in Category 1, four in Category 4, and one in Category 3. The cotton colours gave six in Category 1 and two in Category 3. None in Category 2.

As an outcome of this work it is suggested that there is a selective bleaching power for different wave lengths. The paper concludes that ultra violet light from the mercury lamp is not a satisfactory substitute for daylight in fading tests.

Harrison used two types of lamp for comparison with sunlight—a small Heracus mercury lamp, 110 volts 4 amps., 222 volts 2 amps., and a large Westinghouse mercury lamp 220 volts 3·5 amperes, and with patterns placed 25 cm. from the lamp, exposures were made and the results compared: 140 hours sunlight compared with 24 hours with the small mercury lamp, and 170 hours sunlight with five hours with the large lamp. The results show considerable differences in the relative fading, thus Brilliant Fast Blue 2G 1% gives a fading expressed by 1 unit for sunlight and by the small mercury lamp 8 units, whereas Brilliant Pure Yellow 6G 1% shows 9 units by sunlight and 2 by the mercury lamp.

"The results show an interesting effect; with four yellows tested, Cotton Yellow and Chrysophenine are faster to sunlight than Thioflavine and Auramine. With light from the small lamp the four colours were practically of the same fastness, whilst with the large lamp, which gave a light of high intensity, Thioflavine and Auramine were faster than the other two."

"Light of high intensity does not act relatively the same on all colours as light of low intensity."

A white flame carbon arc of 5,000 c.p. with the globe removed was used by Mott, and was stated to give "essentially similar results" to sunlight, but showed greater speed. Best June sunlight for 50 hours gave an effect equal to between 10 and 20 hours of 28-ampere white flame arc at 10 inches.

There is a growing tendency to rely on the results obtained by exposing patterns to the arc lamp as a substitute for exposure to daylight. We have made a number of comparative exposures of worsted patterns dyed with typical dyestuffs, and in all cases the fabrics were dyed according to the normal instructions of the dyestuff makers. The patterns were exposed to sunlight from 23rd July to 17th September 1925, facing south; one set was exposed in the country 15 miles from Leeds, and the other set in Leeds itself, the average relative humidity being 80·5%. The former, after exposure, were comparatively clean, whereas the latter were dirty and had to be cleansed with Saponin solution before comparison. The patterns were exposed without a glass covering for four periods each of 14 days, so that the shortest exposure was 14 days and the greatest 56 days. It was found by comparison with type exposures that each period of 14 days gave approximately the same amount of fading of a new strip. The faded patterns were examined and grouped into five classes representing relative fastness. Patterns from the same dyed worsted were exposed to the arc for two periods each of 70 hours. The patterns were placed 10 inches from the arc at an average temperature of 132° F. and approximately 75% R.H.

The two sets were compared and it was found that different dyes exposed to the arc lamp showed a different relation to the sunlight fading. A list of results follows. + or − numbers were given to the electric arc faded patterns as they corresponded to the 1 to 4 sunlight fading periods; + signifies more fading than sunlight and − represents less fading than sunlight.

Judgment of the results was entirely by direct observation and no observations were made with a tintometer or other absolute colour measuring apparatus. The figures are, however, sufficiently approximate.

It will be seen that there is a wide variation in the relative fading, but it will be noted that five patterns of Indigo dyed worsted, dyed to shades increasing from a pale sky blue to a full navy, behave identically to sunlight and to the electric arc.

The table below gives opposite to each dyestuff the group of relative fastness to sunlight judged according to the system suggested by us, and figures representing the comparative amount of fading by the flaming arc lamp to exposures in the country (Clifford) and town (Torridon).

From 71 patterns exposed for 42 days at Clifford, 70 hours arc light gave an average fading ratio of 1 : 1·23 and from 140 hours an average ratio of 1 : 1·97. For 60 patterns exposed at Torridon for 70 hours arc light the ratio was 1 : 1·47 and for 140 hours 1 : 1·78.

The main point to notice is that the electric arc fading does not place the dyestuffs in order as regards fastness to sunlight. The second period of exposure in our experiments gives a greater relative amount of fading by the arc than the first period, and further, this relative amount is greater than that of sunlight.

We have not yet had the opportunity of investigating the effect of variation of relative humidity of the atmosphere surrounding the patterns; the relative humidity actually in contact would be affected by absorption of heat and by local temperature. But we give the results because they have

	Name of Colour	Per cent.	Relative Fastness to Sunlight Group	Comparison with Arc Lamp			
				Clifford		Torridon	
				1st Period	2nd Period	1st Period	2nd Period
1	Indigo Carmine X	4	0	—	—	0	0
2	Ponceau RG	1½	I.	− ¼	− ½	+ ½	+ ½
3	Brilliant Bordeaux B	2¾	I.	+1	+1½	+1	+1
6	Xylene Blue AS	3	I.	+1½	+4	+2	+2
7	Azo Rubine	2¾	II.	+1	+1½	0	+ ½
9	Azo Acid Red L	4½	II.	+ ½	+1½	+1½	+1½
10	Victoria Rubine O	3	II.	+2	+2	+1	+2
11	Alizadine Orange M paste	3	II.	0	+3	0	+1
13	Khaki Yellow WN paste	3	II.	− ½	0	0	+1
14	Neolan Violet R	½	II.	+1	+3	0	+ ½
15	Kiton Red S	4½	III.	0	+1½	+ ½	+1
16	Neolan Pink B	2	III.	0	+2	+1	+2
17	Chloramine Fast Red F	2½	III.	+1	+3	+2	+2
18	Chloramine Fast Red F	2½	III.	+1	+3	+2	+2
19	Sorbine Red	4½	III.	+1	+2½	+2	+2
20	Lanafuchsine SG	4½	III.	+1	+2½	0	+1½
22	Erio Fast Fuchsine BL conc.	5	III.	+2	+4	+3	+3
23	Neolan Violet R	0·5	III.	+2	+2	+3	+3
24	Eriochromal Grey R	½	III.	+3	+3	+1½	+2
25	Indochromine RR	3	III.	+3	+4	+2	+2
26	Alizarine Blue SCB	10	IV.	+2	+3	+3	+3
27	Solway Blue Black 3B	4	III.	+2	+3	+1	+2
28	Solway Blue B	4	III.	+1	+2	0	+1½
29	Indigo	—	III.	0	+2	+2	+2
30	Indigo	—	III.	0	+2	+2	+2
31	Indigosol O	15	III.	+2	+2½	+2½	+2½
32	Alizarine Blue Black	4	III.	+2	+3	+3	+3
33	Ultra Viridine	3	III.	+2½	+3	+3	+3
34	Neolan Green B	2	III.	+2	+2	+2	+3
38	Solochrome Yellow Y	1	III.	−1	−1	−1	−2
39	Erio Flavine A conc.	3	III.	−1	−1	− ½	− ½
40	Chlorazol Fast Red FG	2½	IV.	+1	+1	+1	+2
41	Diamine Fast Red F	2½	IV.	+2	+2	+3	+3
42	Diamine Fast Red F	2½	IV.	+1	+2	+3	+3
47	Oxyphenine GG	3	IV.	0	0	−2	−2
48	Metachrome Yellow MY paste	7	IV.	+3	+3	−2	−2
49	Metachrome Violet B	3	IV.	+2	+3	+3	+3
50	Alizarine Blue OCB	5	IV.	+2	+3	+3	+3
51	Alizarine Blue OCR	5	IV.	+3	+3	+3	+3
52	Erio Alizarine Blue G	4	IV.	+2	+2	+2	+3
53	Gallocyanine BD paste	20	IV.	+4	+4	+2	+3
54	Neolan Blue G	6	IV.	+3	+3	+3	+3
55	Indigo	—	IV.	0	0	+3	+3
56	Alizarine Cyanine Green F pdr.	4	IV.	+3	+3	+2	+2
57	Solway Green E	4	IV.	+2	+3	+2	+2
58	Alizarine Cyanine Green G conc.	4	IV.	+2	+3	+2	+3
59	Soledon Jade Green	10	IV.	+2	+3	+1	+2
60	Omega Chrome Brown 2R conc.	3	IV.	0	0	0	0
61	Anthracene Brown WL powder	4	IV.	+3	+3	+2	+2
62	Eriochromal Brown G	4	IV.	+2	+3	+3	+3
63	Alizadine Brown M paste	4	IV.	+1	+2	+ ½	+2
64	Metachrome Brown BR powder	4	IV.	0	+2	+2	+3
67	Naphthol Green B	7	V.	0	0	0	0
68	Indigo	—	V.	0	0	0	0
69	Indigo	—	V.	0	0	0	0
70	Era Chrome Dark Blue B	5	V.	+3	+3	+3	+3
71	Chrome Fast Cyanine B	5	V.	+3	+3	+3	+3
72	Anthracene Blue BDG	4	V.	+3	+3	+3	+3
73	Eriochrome Black T	6	V.	0	+2	—	—
74	Solochrome Black T	6	V.	− ½	− ½	—	—
75	Solochrome Black 6B	5	V.	+1	+3	—	—
76	Solochrome Violet R	3	V.	+3	+3	—	—
77	Chrome Fast Violet B	3	V.	+1	+2	—	—
78	Eriochrome Violet BB	3	V.	0	+2	—	—
79	Omega Chrome Red B	4	V.	0	0	—	—
80	Eriochrome Red B	4	V.	+3	+3	—	—
81	Solochrome Red B	4	V.	+3	+3	—	—
82	Alizarine Red	—	V.	+2	+2	+3	+3
83	Monochrome Brown H paste	4	V.	0	+2	—	—
84	Oxyphenine R	3	V.	−1	−1	—	—
85	Diamine Fast Yellow FF	3	V.	−1	−1	0	0
86	Diamine Fast Yellow FF	3	V.	0	−1	—	—

been obtained in a manner which is generally adopted by the trade. The results are not satisfactory and if such a method is generally used in its present state misleading conclusions will be obtained. Further investigation is necessary and possibly some modification in the source of light will have to be made and method of control of the humidity adopted.

In all these tests the arc was enclosed in a glass globe, since owing to the close proximity of the fabrics to the flame deleterious effects would be caused by scorching and also by the oxides of nitrogen, &c., given off. The effect of the glass globe on the transmitted radiation is of great importance. Luckiesh has given a table for different glasses 2 mm. in thickness, showing their transmitting power and these are tabulated below, together with other results derived from other observers. (See Figs. 8 and 9.)

Type of Glass	Absorption Limit
Vitaglass	2,750 Å
Uviol Crown Glass	2,800 Å
Pyrex Glass	2,900 Å
Common Glass	2,950 Å
Light Crown	2,950 Å
Extra Light Flint	2,980 Å
Medium Crown	3,000 Å
Light Flint	3,050 Å
Best Crown	3,100 Å
Medium Flint	3,150 Å
Ordinary Window Glass	3,300 Å

Quartz varies according as to whether it is fused or crystalline, the latter being much more transparent. Quartz absorbs in the region 1,850 Å. Recent work in America on fused quartz globes shows that comparatively quickly the heat of the arc affects its transparency considerably so that it soon becomes about the same as ordinary glass. (Fig. 8).

A point of note here, however, since wool is of a colloidal nature, is that gelatin is transparent to near and middle ultra-violet radiations. Vitaglass produced by Lamplough contains a large proportion of quartz and other constituents not present in ordinary glass, and has the property of transmitting radiation up to 2,750 Å. It is thus freely transparent to all the ultra-violet rays which occur in sunlight and is highly suitable for the globe construction for the arc in such fading tests. Figure shows the result of tests applied to this glass. It is hoped to use this in future experiments.

The precise influence of temperature in fading is little investigated, although Mott states that in common with the greater number of photo-chemical reactions, the temperature coefficient (i.e., the ratio of the rate reaction at one temperature, to that at 10 degrees lower) of the fading of dyes is small. Schwezoff investigated the effect of temperature on the rate of bleaching of dyed collodion sheets and found that between the approximate limits of 18° and 90° Centigrade the temperate coefficient for visible radiation was only 1·036 to 1·084. It must be borne in mind, however, that aniline dyes particularly, are photoelectric and temperature has small influence on the photoelectric effect. In, however, the case of alkali metals, polarisation of the rays increases the photoelectric effect when the vibrations in the rays are vertical to the metal acted upon. If they are horizontal there is no influence whatever. The photoelectric effect is probably directly proportional to the amount of ultra-violet absorbed (Grotthus' Law). The precise effect of polarised light on the question of fading has been little investigated and consequently the question is one which has yet to be answered fully.

Another point requiring investigation is the angle at which the light falls on the fabric during fading tests. In our experiments the patterns were exposed so that the light fell perpendicular to their surface. In sunlight the light falls at all angles and the effect of this is not yet investigated.

Humidity, however, plays an important part in all textile matters and certainly in fading of dyestuffs it is important. Of the relation of humidity to fading, and of temperature and humidity combined very little is known.

Photometric Investigation

There appears to be little available information about the variation of the fading power of sunlight. G. C. Wardle in a private communication has given us some interesting unpublished results obtained recently by exposing patterns dyed with Victoria Blue to sunlight during six separate months, and the results obtained by exposing to five different cloud conditions.

We have compared the results of the fading in full sunshine with Scott's light table and Burton's exposure table for photographic purposes and the following extract will give some idea of the agreement of the fading of the blue dyed pattern with variation of sunlight.

	Fading Units. Dull Light	Dull Light Ratio. 100 for June	Fading Units. Full Sun	Scott's Table, Ratio
June	10	100	100	100
May	8	80	80	80
April	6	60	60	66
March	5	50	40	50
February	2	20	30	28
January	1	10	25	16·7

It is evident that in full sunshine the amount of fading is in good relation to Scott's light values, in dull light the fading value is one-tenth that of full sun (for general photographic purposes one-quarter is generally correct). It will be noticed that in January there is a falling off in fading value in dull light, whereas in full sun it appears better than one would expect.

The results so far show that sunlight gives a fairly constant relative fading under all conditions for this particular dyestuff; a similar examination of other shades would yield valuable results.

The precise effect of fading by light of various colours or by monochromatic light of different wave lengths has been little investigated. As early as 1885 Depierre and Clouet examined 76 typical colours dyed on calico, in different coloured lights. They found that red rays had the least action, yellow rays exert the strongest action on material dyed red or blue, and blue rays had the greatest effect on orange, yellow, green, and violet. It was also found that white light had the greatest fading action, and that light complementary to the colour of the fabric had a great fading action, and that a coloured light essentially the same shade as that of the fabric had no effect. Thus there is some connection between fading and the wave-length of the incident light.

Gebhard asserted that light of different wave lengths may cause oxidation to proceed in different ways and that oxidation in the light may be different from that in the dark. Really precise and reliable data on this point are scarcely known and this is a problem which needs tackling in a strictly scientific manner.

Technical Applications of the Problem

The production of coloured fabrics necessitates some fairly exact knowledge of the fastness of the dyes used, but unfortunately this information is

by no means accurately standardised, or rather there is no agreed international system of standardisation. The question of relative fastness has been discussed by Commissions both in Germany and America.

The German Commission in 1914 and 1916 suggested eight groups or norms of fastness to light, specifying for each norm a dye of definite quantity and method of application to wool and cotton, so that these standards shall be exposed with every batch of patterns for comparison. Hirst has suggested an alternative scheme of six groups only, in order to simplify and make the degrees of fastness more equal, it also being thought advisable to take each standard pattern to represent the minimum fastness for each group.

It is not always considered necessary to use the fastest dyes for certain articles of commerce. Material intended for a short wearing life only requires a dye which will last for the life of the garment. Also shades are demanded which can only be supplied by means of relatively fugitive dyes; this applies mainly to pale or certain very bright colours.

Another problem arises in the mixing of dyes to obtain certain shades. All the dyes used, frequently as many as three or four, must be of equal fastness, or rather their fastness must be such that the occurrence of fading will leave the material of the same tone as the original. Further we have been approached by practical dyers who have had curious experiences when using mixed dyestuffs. In some cases the mixture is more fugitive than would be expected, but in one case picric acid and indigo carmine, both notoriously fugitive, when mixed in a certain proportion give a fast result.

There is also the question of suitability of certain manufactured materials to withstand the processes required in dyeing. Finally there is the ever-present question of cost. We have tried to induce dyers to use specially fast dyes, but we are confronted with the cost problem, which may, however, prove short-sighted in view of the productions of foreign competitors who are supplying definitely faster dyes to markets where sunlight is more prevalent than in this country.

A method for easy and rapid exposure is necessary so that actual mixtures may be readily tested and also a simple method for recording changes in hue is desirable; if information can be obtained which in some way connects the adsorption spectra with fastness to sunlight, it would be easier to predict the result of combination shades. Or, more precisely, the amount of fading should be ultimately expressed in simple numerals just as the durability of metals can be so recorded.

Amongst previous investigations there are several publications on the technical aspect of fading.

Mott gives a general account of the subject, with particular references to paints.

Cunliffe presents a very complete bibliography of the subject.

Dreaper devotes a considerable space to this matter and there is a concise section in "A Manual of Dyeing," by Knecht, Rawson, and Loewenthal.

Influence of Air and Gases

Before considering the effect of light on dyed materials it is important to eliminate the effect of other causes. The influence of gases which surround the fibres has been the subject of investigation. Chevreul found that if dyed patterns are exposed to sunlight in exhausted glass tubes, and in tubes filled with inert gases, the amount of fading was negligible. More

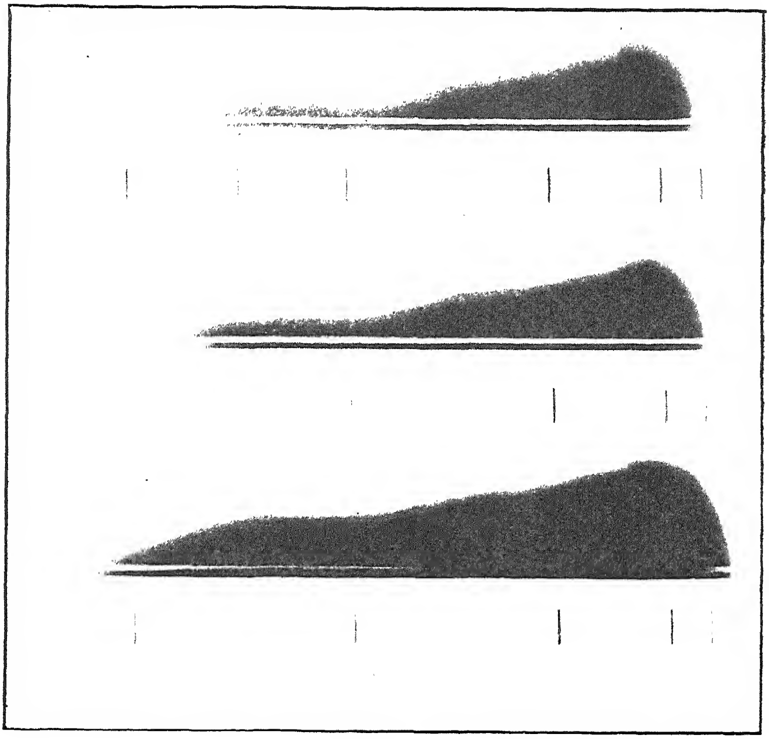


Fig. 3
Typical record showing plate for determination of distribution of energy in various spectra.

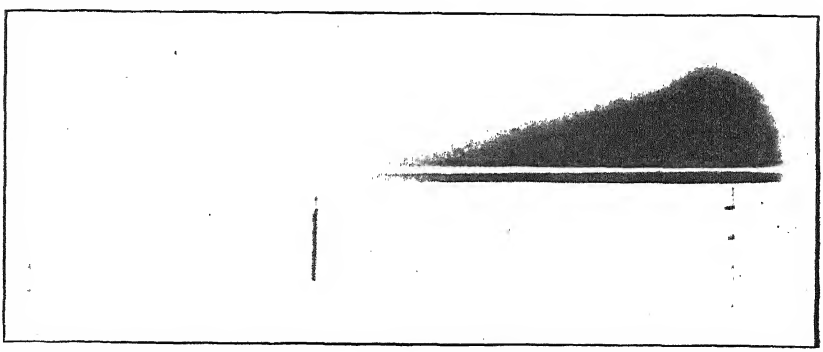
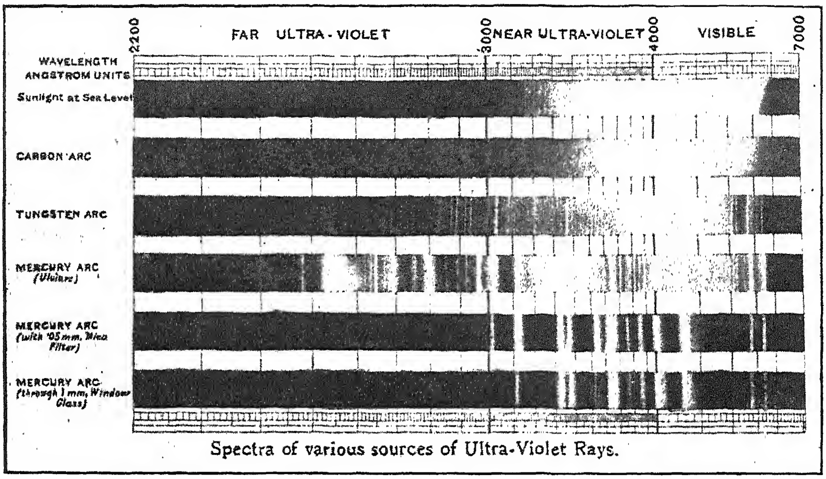


Fig. 4
Enlarged record showing effect of process screen.



Spectra of various sources of Ultra-Violet Rays.

FIG. 6

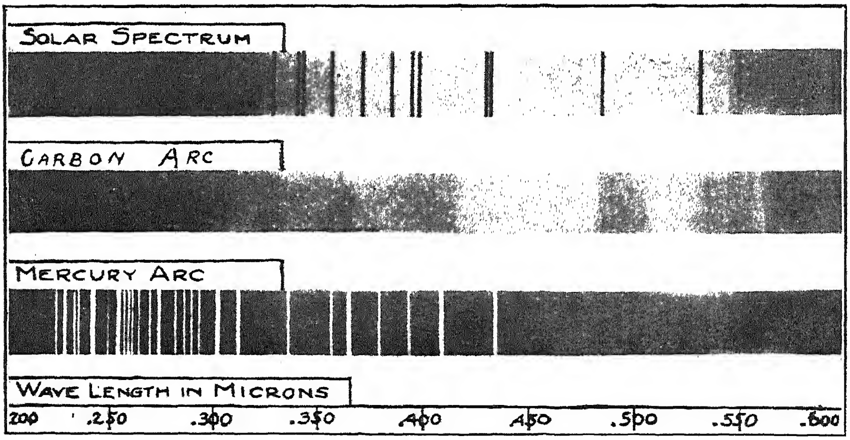


FIG. 7

Comparison of spectra of sunlight, violet carbon arc, and mercury arc.

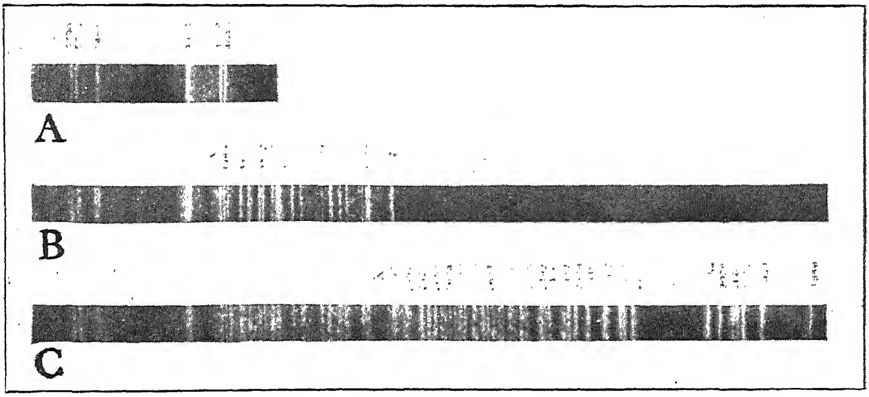


FIG. 8
Spectra of mercury vapour arc taken through various transparent media.
A—Visual spectrum.
B—Transmission through crown glass.
C—Transmission through clear fused quartz.

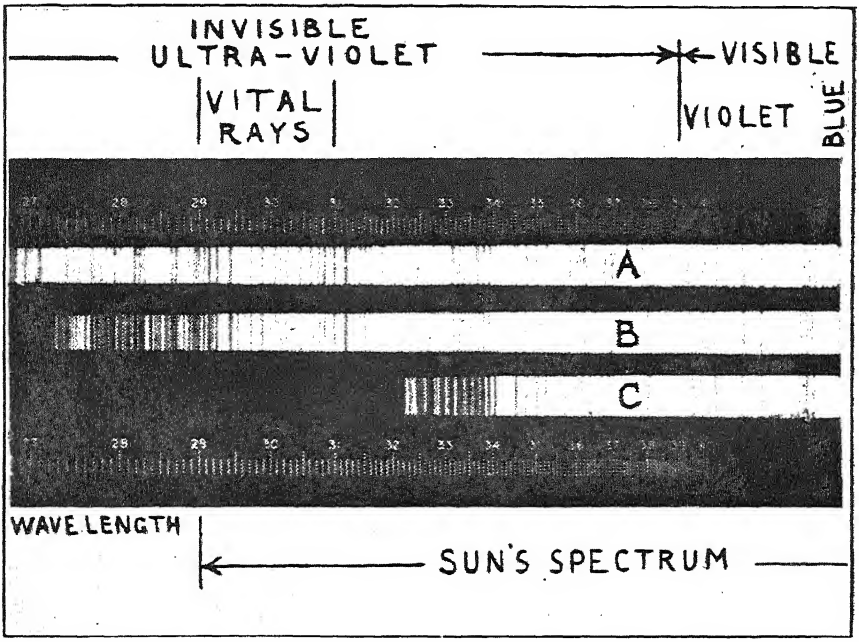
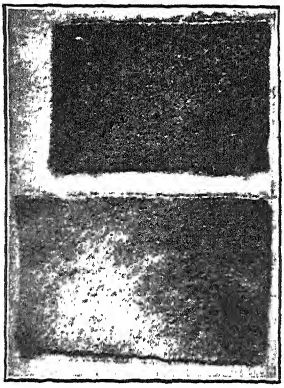


FIG. 9
Spectrum photograph, showing the composition of light from an electric arc between iron poles taken by the Hilger quartz spectrograph with wave-length scale.
A—Light of iron arc without any screen.
B—Light of iron arc passed through vitaglass 2 mm. thick. This shows that vitaglass transmits the vital rays to the extreme limit of the sun's spectrum.
C—Light of Iron arc passed through ordinary glass 2 mm. thick. The vital rays are completely obstructed.



Dry atmosphere.

Saturated atmosphere.

FIG. 10
1% Formyl Violet S4B, exposed to sunlight for 28 days.

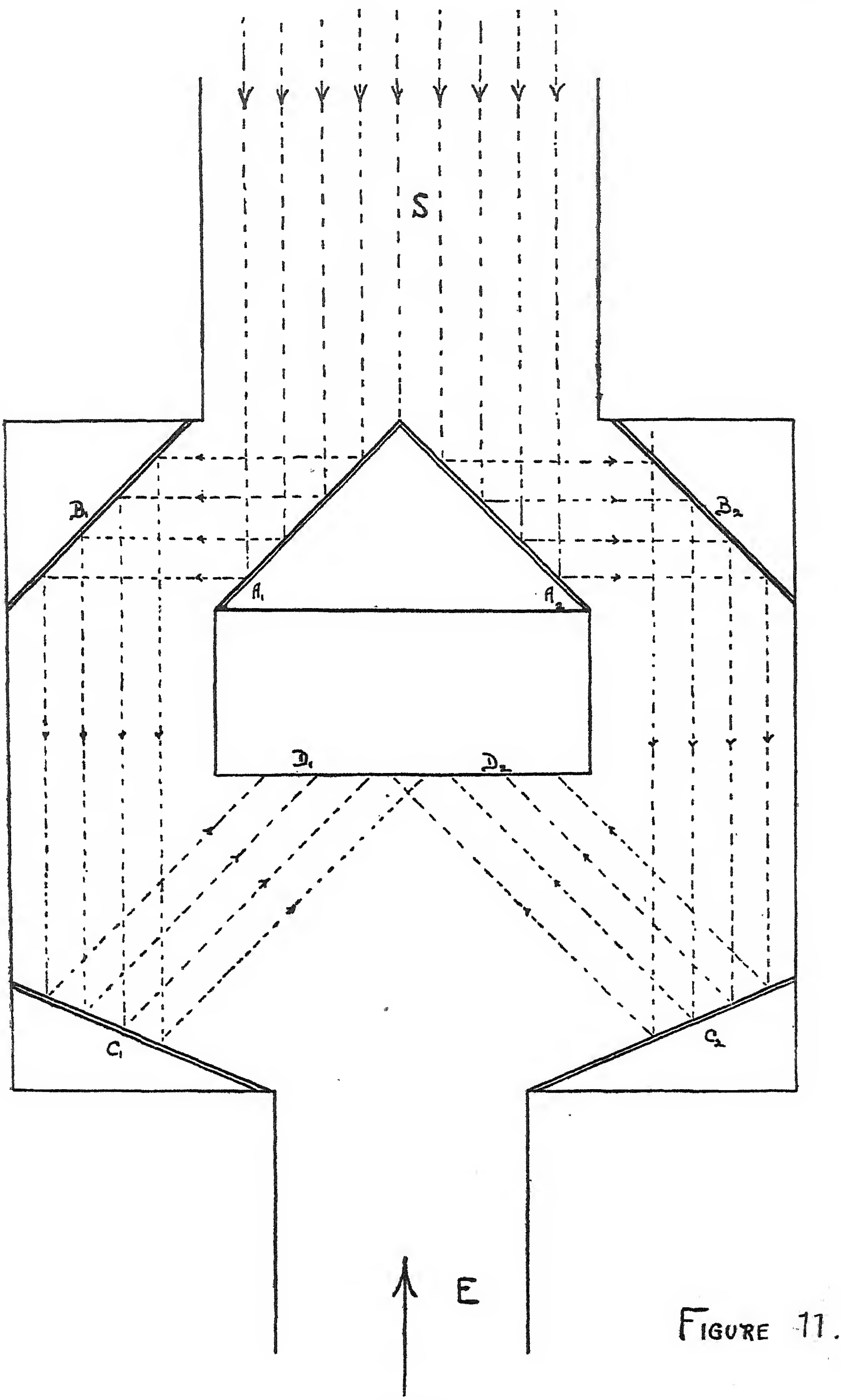


FIG. 11

recently Gebhard and others have confirmed this statement. Moisture without the presence of oxygen and dry oxygen filled tubes, hydrogen or nitrogen gases, and as will be shown later, oxygen and water vapour appear to enter definitely into reaction with the dyestuff fibre system when exposed to sunlight.

Brownlie states that an alkaline atmosphere increases the bleaching effect of sunlight on the dyestuff fibre system. Alcohol and pyridine increase enormously the bleaching effect of sunlight, whereas an acid atmosphere reduces the amount of fading. Choloroform or solvent naphtha slightly retard the fading, and some other organic solvents have no influence.

With reference to the increased fading due to alcohol vapour it has been shown by King that alcohol is absorbed by wool in the same manner as water vapour, and held very tenaciously, so that in the presence of alcohol vapour we have a totally different system and one may expect a definite reaction to take place in the presence of light, with the probable formation of aldehydes or other reducing substances.

The statement that alkali increases fading appears to be generally accepted, but this statement should only be taken as approximate. We have found exceptions to this rule and are investigating the matter more fully; it is, however, important that when patterns are tested that they should be of such alkalinity or acidity as would obtain with the material when in actual use.

The humidity of the atmosphere surrounding the dyed material when exposed to light has a considerable effect on the rate of fading. Brownlie states that the greater the humidity the more rapid is the fading action of light, and that the well-known increased rapidity of fading in sea air is due to greater clearness of the atmosphere, more moisture, and the presence of hydrogen peroxide or ozone, probably produced by evaporation of water from large areas. It must be remembered that there is a large amount of reflected light from large areas of water which will of course increase the total amount of incident light on the dyed material. The same probably applies with regard to the greater bleaching effect of light when snow is on the ground; for instance, in the drying of furs, "burns" occur when they are exposed to the air with snow on the ground, exactly the same as on exposing to hot sunshine. Snow of course reflects ultra-violet rays extremely well.

It is well known that the amount of fading caused by light differs considerably in dry and moist climates where the amount of sunlight can be assumed to be equal. For all standard estimations of fading the degree of saturation of the atmosphere has to be carefully considered.

It is important to remember that in all cases one must not consider the effect of light alone, but light plus atmosphere, and it would be preferable to speak of atmospheric fading rather than light fading. This question of atmosphere is much more important when attempting to substitute artificial sources of light, for sunlight. In any instrument used for the purpose it is essential that the atmosphere surrounding the patterns can be readily controlled, not overlooking the effect of intense radiation in raising the temperature of the solid material.

Chemical Reactions occurring during Fading

From the above it will naturally be assumed that part of the fading is a chemical reaction as well as a physical effect of light itself.

Gebhard assumes firstly a reaction between oxygen and water ions, with the resulting formation of perhydrioxyl ions.

$$\overset{+}{O}\cdot\overset{-}{O} + \overset{+}{H}\cdot\overset{-}{O}H \rightleftarrows HOOOH \rightleftarrows \overset{+}{H}O\cdot\overset{-}{O}OH$$

and, secondly, union of the dyestuff.

Experiments "based on the change in concentration of ions in solution upon electrolysis, have shown that where the concentration of the perhydroxyl ions is highest, the degree of fading taking place in the solution is greatest," and that "dyestuff peroxides" have been formed on the fibre in the case of many differently constituted dyestuffs.

In pure dry air, peroxides of the dyestuffs are formed which are relatively stable, and show reactions for peroxides and not for hydrogen peroxide before any colour change is visible; but on the admission of moisture, perhydroxides tend to be formed and there is a more rapid destruction of colour. We have two types of peroxides formed; $A\langle{}^{O}_{O}\rangle$ a relatively stable form and a labile highly reactive form of the peroxide hydrate type $A\langle{}^{O-OH}_{OH}$.

The dyestuff peroxides are formed during exposure to dry air, but peroxide hydrates result from the addition of perhydroxyl ions produced by the union of oxygen atoms with the ions of water. "The peroxide hydrates are highly reactive and the active oxygen they contain may act on the unchanged molecules of the dyestuff and upon other members of the system (for instance, the fibre) with the production of acids and phenols. The existence of acid groups produced in some such manner has often been noticed."

Even in moist atmosphere peroxides alone may be formed, when from the constitution of the dyestuff or its combination with other substances the peroxide hydrate passes into the more stable peroxide. Such dyestuffs are said to be fast to light, as they give no change on long exposure.

Harrison criticises Gebhard's conclusions and considers that the existence of peroxides in the presence of cellulose is problematical, and that Gebhard omits to consider the fibre itself, whereas under the influence of light and atmosphere, the fibre may have a reducing action. Harrison has shown that certain colours are bleached by light from the mercury-vapour lamp in the absence of air, but in the absence of the fibre they were unaffected. There is no doubt that, under the action of light, wool fibre is changed in composition, its colour and strength being altered, and also its capacity for redyeing begin much altered. Under the influence of light many possible reactions may occur—

(1) The light may convert oxygen into ozone, and this or the ozone itself may oxidise the dyestuff.
(2) The fibre may reduce the dyestuff.
(3) Or both these reactions may occur at the same time.
(4) The air or ozone may oxidise the fibre and produce substances more capable of reducing the dyestuff.
(5) The air or ozone may oxidise the dyestuff and produce a substance more easily reduced by the fibre and its oxidation products.
(6) The fibre may reduce the dyestuff or otherwise react with it to produce substances more easily oxidised by the air.
(7) The light may cause one portion of the colour molecule to react with another.

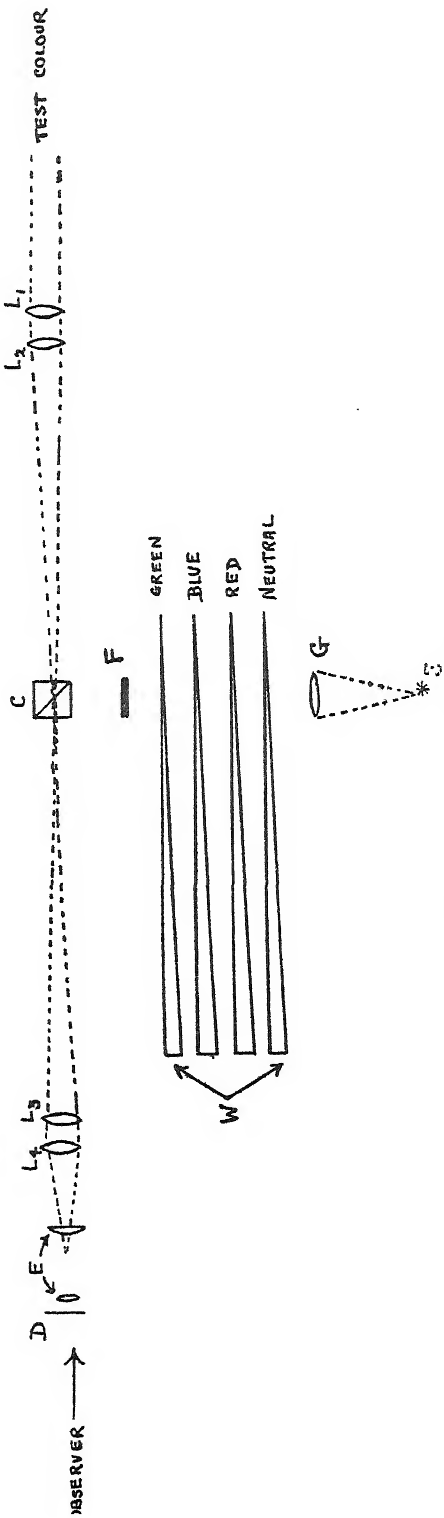


FIG. 12—Eastman Colorimeter.

He considers that each theory may be correct, but is applicable to a limited number of dyestuffs.

H. S. Hirst and E. K. Rideal, in a recent letter to *Nature*, state that during the course of an investigation on the photochemical combination of gases their attention was directed to the marked diversity in the rate of combination of gases such as hydrogen with oxygen, &c.

The authors proceed to note their own work on the catalytic action of a mercury surface, and show that in the presence of the same there is considerable acceleration of the rate of reaction. They had, however, not completed the investigation of the influence of water-vapour on such surface reaction. This work is of great interest from our point of view since fading is probably a photochemical surface reaction. It is possible that the variation in rates of fading is partially due to variation of catalytic power of the substances upon the fibre surface around it, such as the dyestuff itself, water vapour, &c. In the case of different kinds of fibres the amount of reaction may vary with the surface area exposed to the fading agency. Cotton fibres are of a flat, ribbon-like nature, whilst those of wool are elliptical and almost circular in cross section. The action of water vapour in such photochemical reactions is of supreme importance since wool is so very hygroscopic in nature and its physical properties are so variable according to its moisture content. The precise function of water in the fading process is, as yet, unknown.

Brownlie discusses the relation of chemical constitution of dyestuffs to fastness to light, and their behaviours towards oxidising and reducing agents—the results are confusing but he classifies them as follows—

(1) Colours derived from phenol and its homologues and their sulphonic acids and carboxylic acids are fast to light, fast to oxidising agents, although turned a trifle darker in colour, and fast to reducing agents.

(2) Colours derived from phenols containing more than one hydroxyl group are loose to light, and as regards oxidising and reducing agents vary from loose to fairly fast.

(3) Colours derived from alpha and beta naphthols are loose to light, fairly fast to oxidising agents and loose to reducing agents.

(4) Colours derived from amidonaphthol sulphonic acids 2 : 8 : 6 and 2 : 8 : 3 : 6 are fast to light and loose to both oxidising and reducing agents. Those from 1 : 8 : 3 : 6 and 1 : 8 : 2 : 4 are loose to light, not fast to oxidising agents, and loose to reducing agents.

As oxidising agent, N/50 permanganate was used and, as reducing agent, dilute hydrosulphite solution. The dyestuffs were direct cotton colours.

He gives lists of dyes showing the influence on the fastness of the dye molecule, by the addition and substitution of various radicals and apparently the fastness can be more or less accurately known by the chemical constitution, but so far no apparent theoretical connection is discernible.

Influence of Oils, &c.

Hannay experimented with dyed cotton cloth treated with oils, soaps, &c., using ammonium soaps of various fatty acids. Castor oil fatty acids increase fading, whereas stearic acid has a protective influence. The general conclusion is that unsaturated fatty acids present in greater or less degree influence fading in the same proportion.

These results are not surprising, for fatty oils which contain unsaturated groups form stable peroxides in dry air, which readily liberate oxygen in the

presence of moisture. We have no information with regard to the action of oils on the fading of wool dyed material, but an investigation would be worth while because manufactured wool practically always contains about 1% of fatty acid after scouring.

Dextrine is known to increase the fastness of dyes.

The reduction of colour may be due to either oxidation or reduction. The formation of a dye is generally an exothermal process, whilst its decomposition is due to an endothermal reaction which is brought about by the application either of light or of electrical energy. Grotthus stated that only those rays of light which are absorbed are effective in producing chemical change. The law of Ritter, Herschel, and Becquerel states that rays of long wave length exert an oxidising action as opposed to the reducing action of rays of short wave length. It thus appears as though both types of reaction can occur and, arguing from the statement that absorbed rays are effective, some relation might be established between the fading of certain colours, say red or blue, and their behaviour to oxidising and reducing agents.

It has been found that in some cases light does cause change in chemical constitution; e.g., Kernbaum finds that distilled air-free water in a quartz vessel evolves gas in a few hours when exposed to light, showing that water has been decomposed by the light. Tian finds that the velocity of decomposition of hydrogen peroxide in aqueous solution increases with increasing frequency of the exciting ultra-violet radiation.

The action of light on ferric salts is well known; they are reduced to ferrous salts. We have an example of a piece of white worsted cloth which was contaminated with iron during the bleaching with SO_2 when the iron would be present as ferrous sulphite. The action of light has formed a brown stain of a ferric salt. Thus here we have a definite case of light acting as an oxidising and as a reducing agent.

It is also known that when Professor Rutherford exposed dyed patterns to positively charged helium atoms from radium emanation, cellulose was greatly damaged and many direct and basic colours and indigo were bleached, but little action was observed on Indanthrene and Para Red. "Flavanthrene was turned green just after exposure, showing that it was reduced presumably by the oxidation products of cellulose." From the table of results the effect of radium emanation is different in degree and quality from sunlight.

Influence of Sunlight on Wool

It has been observed that when undyed wool is exposed to sunlight a considerable amount of acid wool products are formed and are readily soluble in alkali. The brownish colour given by long exposure is similar to that obtained by a short exposure after an alkaline treatment, and both can be removed by acid. V. Bergen shows that sunlight destroys the epithelial scales and then the fibre is readily damaged by dilute alkali, and that wool wetted with 0·5% solution of sulphuric acid prior to exposure was far more damaged than wool previously wetted with a 1% solution of carbonate of soda. After exposure to sunlight more acid was found in the acidified fibre than was originally present. This he explains by the generation in the fibre of free acid from the sulphur which it contains.

As dyes on acid wool are generally less affected by sunlight than alkaline wool, it is suggested from the above that the fibre and the decomposition of the fibre is not such a serious factor with dyed wool as with cotton, and

there is a considerable difference in the behaviour of the two fibres dyed with the same dyes, to the action of light. We have examined fibres submitted to the action of a flaming arc lamp and notice that a similar disintegration takes place, and also the formation of acid products producing a yellow colouring matter when neutralised.

Measurement of Colour

To turn to the question of colour matching, it is of extreme importance that the amount of fading should be measured absolutely. The exact amount of fading as also the exact depth of colour in a particular shade is a matter of great urgency. In order to obtain really scientific information, account must be taken of the constitution of the light reflected from the dyed material and not of the dye in solution. There are many records of visible absorption spectra of dye solutions but none available for the constitution of the light reflected from dyed patterns. In many cases the colour of the dye solution is quite different from that of the dyed cloth.

To turn to colorimetric measurement a brief survey of the various methods available is given below.

Colorimeters measure colour in terms of its visual appearance, and not in terms of spectral distribution. The stimulus corresponding to a given colour sensation may be expressed algebraically in terms of the amount of red, green, and blue stimuli required to form a mixture corresponding to the stimulus specified. The most frequent application of colour measurement is the reproduction of the stimulus resulting from the illumination of a "coloured" surface by white light. The possible variations in the colour of certain articles when viewed under daylight and artificial light alternately are well known, and also there is variation according to the direction in which the articles are viewed, owing to diffused reflection of the light. It is necessary in colorimetry to specify a standard method of illumination and observation. Dr. Martin and others have suggested that the illumination shall be parallel white light incident at 45° to the normal, and that the direction of view shall be normal to the surface illuminated.

An instrument for obtaining uniform illumination by daylight over a limited area, as shown in Fig. 11, has been devised in our laboratories. The light enters through a rectangular opening S and is incident on the two plane mirrors A_1 and A_2, placed at right angles to one another and so that the light rays are incident at 45°. The light, after reflection at these mirrors, falls on to the two plane mirrors B_1 and B_2, and, after reflection at these, is incident on the two plane mirrors C_1 and C_2. These mirrors are very lightly ground, so that there is some diffusion of the light. After the final reflection at the mirrors C_1 and C_2, the light is incident on the two surfaces D_1 and D_2. The mirrors are arranged so that the angle of incidence of the light is 45°. Hence any materials to be tested for colour are inserted at D_1 and D_2 and are observed through the rectangular opening at E, thus being seen under uniform illumination by light incident at 45° to the normal.

The chief essentials required in a standard source of illumination for colour comparison are (1) that the photometric intensity should be constant, (2) that the distribution of energy in the spectrum should also be constant and should conform to some prescribed standard giving the physical and visual effect of average daylight.

Colorimeters are instruments for mixing certain primary colours in order to obtain a desired colour. These primary colours are fixed arbitrarily for

the various instruments, but Guild has shown how the various results can be transformed into terms depending on standard primaries, these being defined by appropriate spectrum lines.

For purposes of colour matching, the most satisfactory instruments probably are the tintometer, the Eastman colorimeter, and the Guild trichromatic colorimeter. Of these the first two depend on the subtractive mixture of three primary colours. These colours are arbitrarily produced

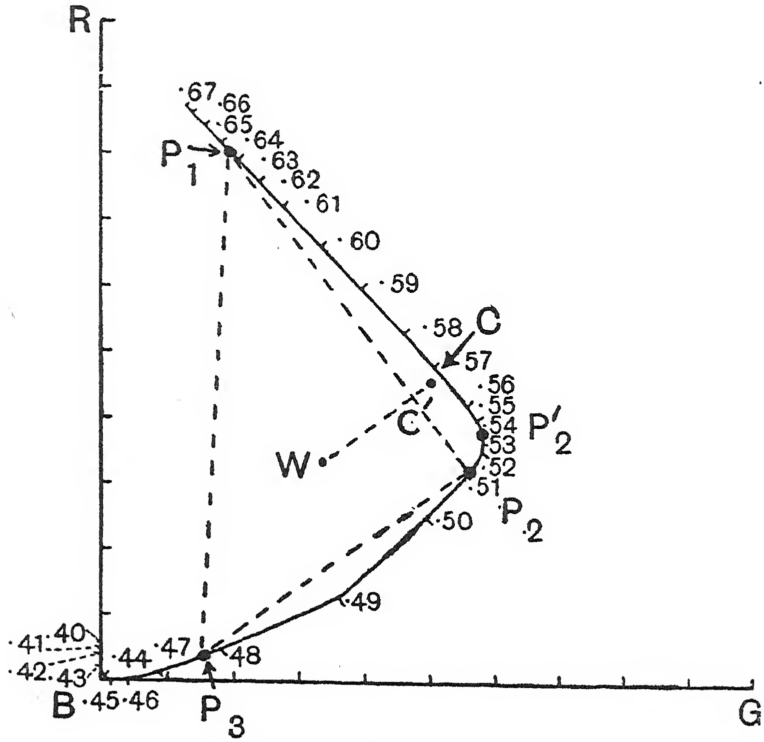


FIG. 13

by colour filters of red, green, and blue glass (or gelatine). The light is made to pass through varying portions of the filters, and hence any desired intensity can be obtained and it is possible to match almost any colour, except a limited range of the more saturated hues intermediate between the primaries.

The principle of the tintometer is given below. The filters consist of flashed glass with varying saturations of the subtractive primaries (crimson, yellow-green, and blue), a complete colour matching set numbering 465 glasses. The steps of depth of colour are adjusted so that combination of equal numbers of the three colours gives greys, and any colour can be expressed as (x red, y yellow, z blue). Light from a white plate passes through the filters and illumines half the field of view, white light from the pattern under test illumines the other half. The glass filters are permanent, so that the only precaution necessary is to control the light used. This should be diffused light from a north window. Since the grey combinations of filters of equal scale number have a somewhat high transmission in the extreme

red, care must be exercised when choosing the standard source of light that it does not contain any excess of red.

Every set of glasses for the tintometer undergoes elaborate tests before leaving the manufacturer, and the accuracy of reproduction appears to be high. Since no optical dispersing system is employed, no great intensity of light is required. and further it is beyond doubt that the steady and uniform matching field offers the best conditions to the eye. The illumination used for the colours under test is daylight from the north.

Lowry and M'Hatton have tested the calibration and they point out that the densities of the filters should be proportional to the scale numbers. The density of a filter is defined as the logarithm of the opacity where

$$\text{opacity} = \frac{\text{intensity of incident light}}{\text{intensity of transmitted light}}$$

i.e., $\log O = \Delta a S$

where O=opacity, Δ=density, S=scale number.

Consider three filters of opacities O_1, O_2, and O_3 placed together so that light traverses each in turn, then the combined opacity of the filters$=O_1 \times O_2 \times O_3$ =incident light/transmitted light.

Taking logarithms, $\log O_1 + \log O_2 + \log O_3 = \log$ (combined opacity). Therefore if the scale numbers S_1, S_2, and S_3 of the filters are proportional to the densities, the scale number corresponding to the effect of the three in series will be $S_1 + S_2 + S_3$.

Lowry and M'Hatton give a curve showing that a linear law is obeyed within small limits of error, especially for numbers above 3. The law appears to be somewhat different between 0 and 3.

In making matches with low scale numbers it is advisable to compensate for the light reflected from the surfaces of the glasses by using an equivalent number of plain glasses in the beam from the substance under test. This will usually allow an exact match in intensity as well as in hue.

The Eastman colorimeter is represented diagrammatically in Fig. 12. C is a Lummer-Brodhun prism consisting of two prisms in contact, arranged so that one prism is illuminated by the standard light and the other by light from the colour to be matched. Light from a standard lamp S passes through dyed gelatine wedges of neutral, red, green, and blue colour, by which almost any desired colour can be produced through variation of the relative positions of the wedges, each being furnished with a scale. The light from these filters illuminates one-half of the field of view. The filter F is capable of reducing the light from the lamp S to the visual quality of noon sunlight. The other half of the matching field is illuminated by an image of the object under test, projected by the lenses L_1 and L_2. One of the features of the apparatus is that fittings are provided for illuminating the test substances with colour-corrected lamps. When testing opaque materials, the light is incident at 45° to the normal to the surface, while the line of view is normal. This instrument is simple to use and has very few parts which require adjustment.

Optical wedges, as used in the Eastman colorimeter, have been largely employed for work in the visible region of the spectrum. Dr. Toy (*Phil. Mag.*, 1920) showed that neutral grey gelatine wedges between quartz plates could be used down to about 3,000 Å.U., but the absorption-coefficient, and hence the wedge-constant, was increasing so rapidly with decreasing wave length that they would probably be useless beyond 2,900 Å.U. However,

G. M. B. Dobson and D. N. Harrison find by measuring the constants of such wedges on an accurate spectro-photometer, using a sodium-in-quartz photo-electric cell, that the constants actually increase but slowly beyond 3,000 Å.U. Using a newly-constructed wedge embodying certain improvements, the change in wedge-constant with wave length is found to be considerably smaller than that of a wedge of standard type, and either type of wedge can easily be used down to 2,380 Å.U.

The Guild trichromatic colorimeter is an additive instrument, and is the most recently invented. Fig. 13 shows the locus of pure spectral colours on a trichromatic chart. Every possible colour is represented by a point on this chart, and all the colours producible by mixing two constituent colours in various proportions are represented by point on the straight line joining the points which represent the constituents. Since all colours are due to the admixture, in various proportions, of the spectrum colours, then all colours are located in the area bounded by the spectral locus and the straight line joining its two ends, and this area is known as the colour field. Its precise shape and position on the chart depend on the particular trichromatic primaries for which the chart is drawn, but the essential characteristics are unaltered by such purely mathematical transformations.

It will be seen from the shape of the colour field that it is not possible to find three primary colours such that suitable combinations of them will give all other colours, for no triangle having its corners within the colour field can contain the whole field.

Let the primary colours of an instrument be the fully saturated colours P_1, P_2, and P_3 (Fig. 13). Then, as long as the primaries can be mixed to give white, i.e., as long as $P_1P_2P_3$ contains W, any desired hue can be obtained. A line from W to any point on the periphery of the field is a line of constant hue, the saturation being greatest at the periphery. But consider the colour C: the most saturated colour of the same hue is C^1, which may be produced by mixing P_1 and P_2 alone. This illustrates the result obtained in practice, namely, that spectrum colours cannot generally be matched by a trichromatic mixture. In order to measure a colour of higher saturation, a colour is added which will modify the given colour and bring it within the triangle. Then the modified colour is measured in terms of the primaries, and also the modifying colour alone is measured, and from these results the test colour can be found. Thus let the readings for the modified colour be

$$\alpha P_1 + \alpha^1 P_2 + \alpha^{11} P_3$$

and let the readings for the modifying colour be

$$\beta P_1 + \beta^1 P_2 + \beta^{11} P_3$$

then the readings for the colour under test will be

$$(\alpha - \beta)\ P_1 + (\alpha^1 - \beta^1)\ P_2 + (\alpha^{11} - \beta^{11})\ P_3$$

Since the colour cannot be directly matched, one of these coefficients will have a negative value.

Fig. 14 is a diagram of the Guild colorimeter, and Fig. 14a is a view of the side which is presented to the light-source. The shaded areas in the latter figure represent sector-shaped apertures each about 59° angular extent; these apertures are backed respectively by red, green, and blue gelatine filters mounted between glass plates.

The source of light is a 105-volt 100-watt "Fullolite" lamp, which has an opal spherical bulb about 8 cm. in diameter, and forms an extended source of fairly uniform brightness over its whole area. The lamp is placed with its centre at the focus of the outer zone of a condensing lens, which thus throws

a circular beam of parallel light on the coloured apertures in the end of the box. Inside the box a prism CD is mounted so that it can rotate about an axis DE. During rotation the end C passes each of the sectorial openings in turn, and when C is opposite a sector light enters the prism, and, after internal reflections of the inclined faces, emerges along DE.

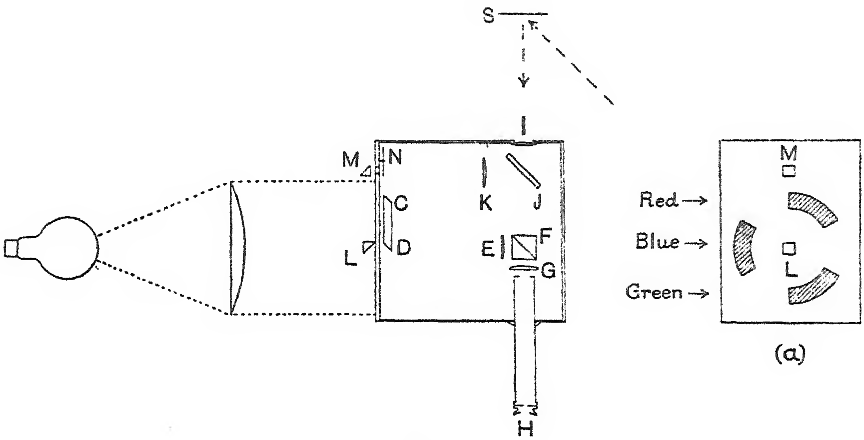


FIG. 14

A lens E is placed so that the effective stop, a circular hole in the mount of the prism CD is at its focus. F is a photometric prism to provide the matching field. This prism consists of two 45° prisms with one-half of their hypotenuse surfaces in optical contact. The line of division of the two portions is horizontal. A stop with a square opening of side 9 mm. is fitted between the cube and the lens G. The field of view, therefore, consists of two horizontal strips, 9 by 4·5 mm., and when the instrument is properly adjusted, the dividing line is practically invisible when a match has been obtained.

G is a lens with its focus at H, and an observer at H sees the reflecting section of the field illuminated by light from the particular sector to which C is opposite. Thus the colours red, green, and blue successively enter the eye, and when the speed of rotation of CD is sufficiently rapid, the colour sensations mingle and a mixed colour is observed. Each sectorial opening is fitted with a shutter so that the relative durations of the various stimuli can be altered, and hence various colours can be obtained.

If the colour to be matched is that of an opaque object, then the specimen is placed at S and illuminated by light incident at 45° to the normal. The colour is then seen uniformly in the field of view of the prism F. If the colour under test is that of a transparent substance, a white screen consisting of a plate heavily coated with magnesium oxide is placed at S and the specimen is placed against the window I.

In general the illuminant used is supposed to be white light. While there is no universally accepted standard of white light, it is usual to adopt as white a light having an energy distribution, within the visible spectrum, of a "black body" at 5,000° K. Daylight itself is too variable in colour, and all laboratory sources are of a much lower colour temperature than 5,000° K., so that a bluish filter has to be obtained with them to obtain white light.

The region of colour temperature for which the most reliable data exist is that obtainable from vacuum metal-filament lamps at approximately normal efficiencies. A point of particular interest within this range is 2,360° K., which may also be obtained from an acetylene flame, using the Eastman-Kodak standard burner.

Dr. A. F. A. Young has investigated the matter of standard white light, and has worked out a filter which will raise the apparent colour temperature of a source at 2,360° K. to 3,000° K. This filter, when placed between a source at 2,360° K. and the screen of a photometer, will give to the latter the colour corresponding to 3,000° K. A gas-filled lamp is arranged on the other side of the photometer and its voltage adjusted until a colour-match is obtained, when it will be operating at a colour temperature of 3,000° K. The lamp may then be used at this voltage as a sub-standard of the colour temperature 3,000° K., to serve as the basis of the white light. Needless to say, the voltage at which it is to be operated must be frequently revised by matching against the initial standard source at 2,360° K., as the ageing of the sub-standard is fairly rapid when run at such a temperature. It is necessary to procure lamps with a normal operating voltage considerably under the supply voltage, otherwise it may be impossible to reach the desired colour temperature. Low-voltage lamps with thick filaments are more suitable for running at such a colour temperature than high-voltage lamps of small current consumption.

A second filter is now required to raise the colour temperature from 3,000° K. to 5,000° K.

Approximately correct filters for use as above are—

2,360° K. to 3,000° K.: Solution A—Copper sulphate
Ammonia (density ·90)
Distilled water to
Solution B—Copper sulphate
Cobalt sulphate
Distilled water to

Solution A and solution B are contained in separate compartments of a double cell, of which the walls are of one of the white optical glasses (say, hard crown). The thickness of each solution should be 10·00 mm.

3,000° K. to 5,000° K.: Solution A—Copper sulphate
Ammonia (density ·90)
Distilled water to
Solution B—Copper sulphate
Cobalt sulphate
Distilled water to

A similar cell should be used as in the case of the other filter.

These solutions will enable a much closer approach to a standard white light to be obtained than any of the filters at present available. In the Guild colorimeter the colour to be matched enters at I and light from this aperture fills the transmitting portion of the prism F. A lens of about 20 cm. focal length is fitted at I, and if objects possessing structure, such as fabrics, &c., are placed near the focus of this lens, the structure will be imaged at H, and a uniform illumination is obtained in the field of view. Otherwise the structure would be visible in the field of view and correct matching would be impossible.

In order that the colour under test may, if necessary, be desaturated sufficiently for a match to be made, a plane parallel glass plate J is inserted in the test beam. Light is reflected by the 45° prisms L and M through a

hole in the box. It passes through a regulating filter consisting of a circular lamp-black-in-gelatine wedge and then *via* the lens K and the reflecting J plate to the photometric prism. The lens K is merely to collimate the light from the aperture M, so that an image of this aperture is primed at H. Thus this added light illumines the part of the field of view which is occupied by the colour under test. The density difference between the lightest and darkest settings of this filter is about 2, giving a variation of 100 to 1 in the intensity of the light transmitted. By inserting colour filters between the prism M and the aperture, the added light can be made of any desired colour.

If the test field is brighter than can be matched by the instrument, its brightness can be reduced either by increasing the distance of the illuminant from S, or by inserting a rotating sector disc in the path of the beam. No so-called neutral filter can be used for this purpose.

On the other hand, if the colour under test can only give a feeble luminosity, the sector openings required for a match will all be very small, and hence percentage accuracy in reading their positions will be low. In such cases a neutral glass filter, transmitting about one-tenth of the light, is placed in front of the "Fullolite" lamp: then the sector openings will need to be about ten times as great in order to give the required match.

The possibility of standardisation of the colours and shades of all dyestuffs on some definite system is absolutely vital to the dyer, and a method of determining the exact amount of fading under various conditions so as to grade these dyestuffs into order of fastness or fugitiveness is equally important to the textile trade. In conclusion we would point out that dyeing is not only a science but would also consider the old time method spoken of as the "art of dyeing." There are many unknown variable factors such as the varying selective affinity of wool fibres for dyestuffs, &c., which have to be remembered and which are corrected directly by experience and judgment of the operator. Yet scientific investigation is an absolute essential to the future progress of the dyer, and, in presenting the problems as stated at the beginning we put forward what we consider the most important of the questions to be answered before further work can proceed.

Finally we would like to thank Mr. J. Guild, Dr. L. C. Martin, and Mr. G. C. Wardle, Messrs. Cox, Cavendish & Co., and Messrs. Kelvin, Bottomley and Baird for their kind help rendered to us during the writing of this paper.

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46—THE DETERMINATION OF DELIQUESCENT SUBSTANCES IN SIZED COTTON MATERIALS

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INTRODUCTION AND SUMMARY

The determination of the constituents of sized materials presents difficulties, first in the extraction, and secondly in the measurement of the small quantities obtainable from a convenient bulk of the sized material. Methods are now described for the determination of chlorides, zinc, magnesium, and glycerol which yield trustworthy results with quantities of sized material easily dealt with on the laboratory scale.

Chlorides are extracted by means of nitric acid and titrated by the Volhard (thiocyanate) method. Magnesium is precipitated from the extract as magnesium ammonium phosphate in the presence of free ammonium hydroxide, and zinc is then precipitated as zinc ammonium phosphate by rendering the filtrate neutral with acetic acid. The magnesium and zinc ammonium phosphates are separately collected and converted into ammonium phosphomolybdate precipitates and these are washed until neutral to litmus and dissolved in a definite quantity of normal sodium hydroxide solution. The unused alkali is finally titrated with normal hydrochloric acid and the zinc or magnesium calculated from the relation, 1 gram equivalent NaOH (1000 cc. of N-solution)=3.00 grs. P_2O_5=2·77 grs. Zn (5·80 grs. $ZnCl_2$)=1·03 gr. Mg. (4·04 grs. $MgCl_2$).

Glycerol is extracted by a mixture of alcohol and ether and oxidised to carbon dioxide by means of sulphuric acid and sodium dichromate in a gas burette. The volume of gas obtained is a measure of the glycerol according to the relation. 1 litre dry CO_2 at N.T.P.=1·369 grs. glycerol.

DETERMINATION OF CHLORIDES

Preparation of Extracts

(i.) *Cloth or Yarn.*—About 5 grams of the material are extracted by boiling with 20 ccs. of $2N$ nitric acid and 300 ccs. of water for one hour in an open flask. The liquor is then decanted and filtered, more water (about 100 ccs.) is added to the material and the extraction repeated. The two filtrates are mixed and made up to 250 ccs. (Extract A).

(ii.) *Size.*—About 1 gram of the wet size is heated overnight with 10 ccs. of $2N$ nitric acid at about 90° C., and the almost clear liquor (filtered if necessary) is suitable for chloride estimation. (Extract B).

Analysis of Extracts

One hundred ccs. of extract A, or the whole of extract B, are treated with an excess of 0·1 N silver nitrate solution, boiled to coagulate silver chloride, filtered, and the precipitate washed with hot water. The filtrate and washings are titrated with 0·1 N potassium thiocyanate in the usual way.[4]

The method has been checked by incorporating known amounts of chloride in a starch paste and analysing portions of the paste, and by sizing yarn with a measured weight of paste of known chloride content, and analysing this. Typical results are given in Table I., where the figures for chlorine found have been corrected for the raw cotton blanks, which are discussed below (p. 515).

Table I.

Material Analysed	% Chlorine from Mixing	% Chlorine Found		
Farina paste	$0{\cdot}36_6$		$0{\cdot}36_6$	$0{\cdot}36_0$
Sago paste	$0{\cdot}14_2$	$0{\cdot}14_2$	$0{\cdot}14_4$	$0{\cdot}14_2$
		$0{\cdot}14_3$	$0{\cdot}14_2$	$0{\cdot}14_1$
American yarn sized sago	$0{\cdot}46_0$		$0{\cdot}46_7$	$0{\cdot}47_4$
American yarn sized maize	$0{\cdot}24_1$		$0{\cdot}24_6$	$0{\cdot}24_6$

DETERMINATION OF ZINC AND MAGNESIUM

Preparation of Extracts

(i.) *Cloth or Yarn* is extracted as described for the chlorine analysis. (Extract A.)

(ii.) *Size.*—About 1 gram of the size is evaporated to dryness several times with fuming nitric acid in a 250 ccs. hard glass, narrow-necked flask, using a small funnel as a splash trap. The operation must be repeated till all organic matter is destroyed, when the mixture no longer chars. The white residue is dissolved in hot dilute hydrochloric acid and diluted to about 100 ccs. (Extract C.)

Analysis of Extracts

One hundred and fifty ccs. of "Extract A," or the whole of "Extract C," are treated with 20 ccs. of $2N$ ammonium chloride solution and with ammonia till alkaline and then boiled. Any precipitate of brown ferric hydroxide is filtered off, and the filtrate made just acid with hydrochloric acid. The solution is boiled, 20 ccs. of a 10% solution of diammonium hydrogen phosphate are then added, followed by 15 ccs. of ammonium hydroxide (D 0·880), and the mixture is shaken for half an hour in a stoppered bottle, allowed to stand, and filtered. The white crystalline precipitate of magnesium ammonium phosphate, part of which adheres to the bottle, is washed three times with 2·5% ammonia solution. The filtrate and washings are boiled to remove ammonia, cooled, ten drops of 0·4% bromocresol purple solution are added and then dilute acetic acid till the purple colour of the solution changes to a green-grey. After standing for half an hour zinc is quantitatively precipitated from the neutral solution in the form of zinc ammonium phosphate. The crystalline precipitate is soluble in either ammoniacal or acid solutions[6], and is washed three times with small amounts of hot water. The washed precipitates of zinc and magnesium ammonium phosphates are now dissolved on the filters and from the sides of the precipitation vessels with dilute nitric acid—15 ccs. of 25% nitric acid and 20 ccs. water—and the filters washed. The solutions are treated with 25 ccs. of 34% ammonium nitrate solution, boiled, and 50 ccs. of hot 3% ammonium molybdate solution are run in from a tap funnel with constant stirring. After standing for fifteen minutes, the yellow precipitate of ammonium phosphomolybdate is filtered off and washed with a cold 1% sodium nitrate solution till the washings are neutral to litmus.[5] The washed precipitate and filter paper are transferred to a beaker, treated with excess of normal sodium hydroxide solution

and the unused alkali titrated with normal hydrochloric acid, using phenolphthalein indicator. There is no advantage in using more dilute reagents, since the end point is not sufficiently sharp. It has been found by experiment that one gram equivalent of alkali corresponds to 3·00 grams of P_2O_5 when the phosphomolybdate is precipitated under the conditions laid down. From the results the amount of phosphorus in the precipitate and hence the amount of zinc or magnesium in the original sample, are calculated.

The method has been checked by analysing standard aqueous solutions and starch pastes of known zinc and magnesium content, and by noting the reproducibility of results with sized yarn and cloth. Some typical analyses are given in Table II.

Table II.

Material Analysed	Weight taken	Zn calculated as $ZnCl_2$%		Mg calculated as $MgCl_2$%	
	gms.	Present	Found	Present	Found
Aqueous solution ...	10	1·30	1·28	0·91	0·91
	5	0·65	0·654, 0·647 0·672	0·455	0·447 0·452, 0·475
Farina starch paste	10	0·678	0·668, 0·679 0·678, 0·667	0·474	0·464, 0·475 0·469, 0·475 0·467
Cloth for dhooties	2	—	1·34, 1·27 1·29, 1·36	—	2·42, 2·43 2·42, 2·42
Sized cloth	5	—	0·64 0·65	—	2·32, 2·32 2·32, 2·32

DETERMINATION OF GLYCEROL

Yarn or Cloth.—About 10 grams of material are extracted in a hot[1] Soxhlet apparatus with acetone for four hours, and the extract, filtered if necessary, is evaporated to dryness in a distilling flask. The residue in the distilling flask is extracted three times with 25 ccs. portions of a mixture of two volumes of alcohol to one volume of ether in the cold, and the solution is filtered. (Extract D.)

Size.—About 2 grams of the size are ground with 40 ccs. of absolute alcohol, added little by little, 20 ccs. of ether are added, and the clear liquid decanted. The extraction is repeated and the residue is finally washed on a filter with more of the alcohol-ether mixture. The filtrate and washings (Extract E) contain practically the whole of the glycerol.

A little boric acid is added to "Extract D or E" to reduce loss of glycerol* and the extract then evaporated to dryness on the steam bath. The last traces of alcohol are removed by a current of air, blown through the flask for five minutes while still on the steam bath. The residue is washed from the flask with 20 ccs. of dilute sulphuric acid (1 volume H_2SO_4 to 2 volumes H_2O), and shaken in a separating funnel with 60 ccs. of light petroleum to remove any fat which might have been extracted by the alcohol-ether mixture. The aqueous layer is run into an evaporating basin and heated on the steam bath for half an hour to remove traces of light petroleum.

* Solutions of glycerol in 150 ccs. of alcohol-ether mixture (2 : 1) were evaporated to dryness with and without the addition of boric acid and the glycerol in the residue estimated, with the following results—Glycerol present originally ·50 mgms.

	No boric acid	Boric acid (0·5 grams) added
Glycerol found	43; 42 mgms.	47; 47 mgms.

The aqueous layer is now filtered into a gas burette over mercury, 2 ccs. of 40% sodium dichromate solution are added, and the mixture is heated to 100° C. by means of a steam jacket to oxidise glycerol to carbon dioxide. (See Fig. 1.) The gas given off is collected over mercury in a second gas

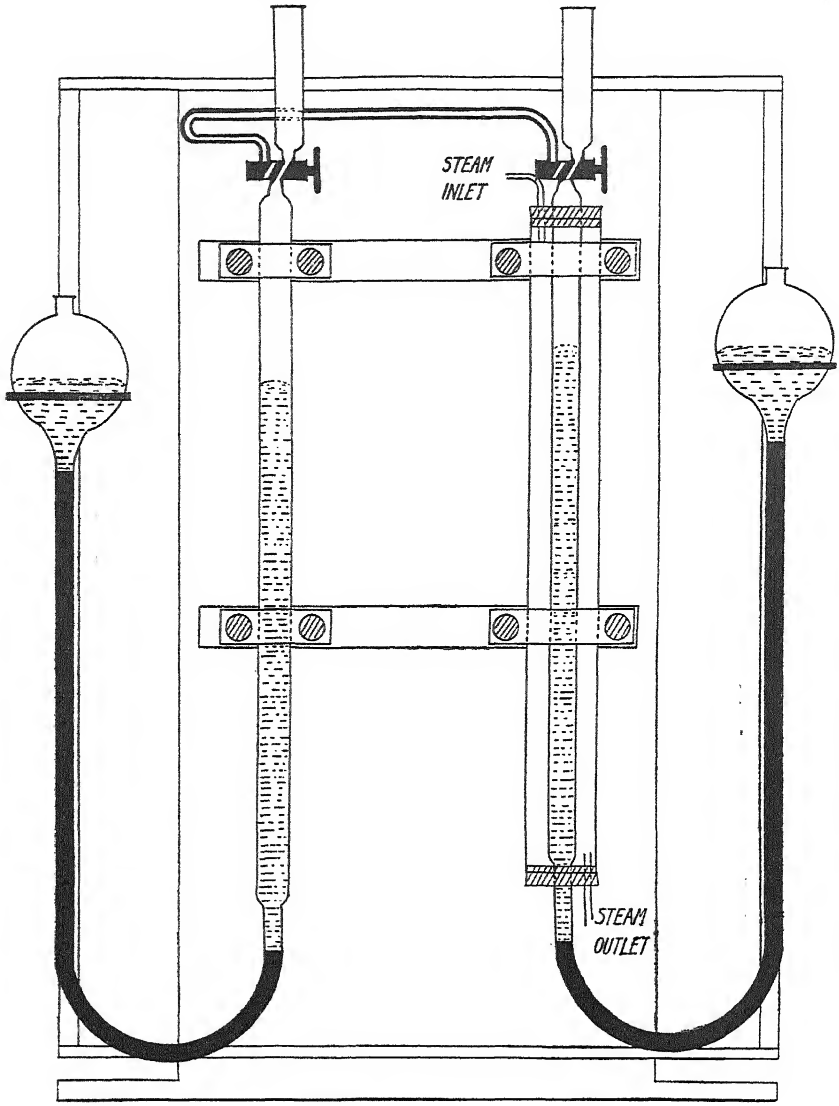

FIG. 1

burette connected to the first by capillary tubing. The last traces of dissolved carbon dioxide are removed from the reaction burette by causing the contents to boil by reducing the pressure after the reaction has proceeded for one hour. The volume of gas (saturated with water vapour) is measured and the small quantity of air (about 0·2 ccs.) estimated by absorbing the carbon dioxide with sodium hydroxide solution. From the volume of carbon dioxide, reduced to N.T.P., the amount of apparent glycerol in the sample is readily calculated. The results of some typical analyses are given in Table III.

Table III.

Material Analysed	Weight taken gms.	Glycerol Present mgms.	Glycerol Found mgms.
Aqueous solution	—	10·3	10·15, 10·3
	—	20·6	18·5, 20·5, 19·0
	—	51·5	51·2
Sized cloth containing tallow, $ZnCl_2$ and $MgCl_2$	6	—	6·0
Sized cloth as above, with 20·8 mgm. glycerol added	6	20·8	24·8, 25·6
Bleached cloth	10	—	3·0
Bleached cloth with glycerol added	10	52	51, 57
5% maize starch paste	—	31·7	29·8, 29·9
Trade size mixing—sago and soluble starches, clay, glycerol, Japan wax, $ZnCl_2$	4	74*	Sample I., 64, 66, 66, 66; Sample II., 65, 65, 67, 67
Yarn sized with above mixing	4	94†	95, 94, 90, 94, 89, 90

* This figure was calculated from the mixing on the assumption that the glycerol used in the mill was 100% pure.

† Calculated from the mean analysis of the size and the total size on the yarn.

A paper by Smith[3] on the estimation of glycerol in sized goods has recently appeared. The quantitative method described therein is possibly more suitable than that now put forward where a fairly large amount is present, owing to the greater selectivity of the "acetin" process of determination as compared with a combustion, but the method apparently breaks down for very small amounts of glycerol.

THE BLANK CORRECTIONS

When the amount of chloride, zinc, magnesium or glycerol present in a sized material is small, the blank correction often amounts to a large fraction of the whole. This correction may be considered as consisting of three parts—

(i.) The method blank, arising from such factors as the partial solubility of, or the absorption of, reagents by precipitates. This is a constant under uniform conditions of working if the same amounts of reagents are used.

(ii.) The raw material blank, due to the presence of small amounts of the substance estimated in the raw material. This tends to make the observed percentage of a size constituent higher than that calculated from the size mixing.

(iii.) The impurity blank, due to lack of selectivity in the method of analysis, whereby substances other than that being estimated pass through the processes with it and increase the final result by an unknown and variable amount.

For the chloride estimation the method blank is too small to be detected, but for the zinc and magnesium estimations, using the amounts of reagents indicated, it is of the order 0·0002 gram and 0·0012 gram respectively. The glycerol method blank is approximately 0·0003 gram, using redistilled solvents. The raw material blanks have been determined for some raw yarns, with the results given in Table IV. (corrected for method blanks).

Table IV.

Sample Analysed	Grams of Constituent per 100 grams of Sample: Chlorine	Zn (calc. as $ZnCl_2$)	Mg (calc. as $MgCl_2$)
Raw American yarn	0·04	Nil	0·25
Raw Indian yarn	0·04	Nil	0·31
Raw Sakel yarn	0·09	0·13	0·47

The figures in Table IV. of course represent the sums of the raw material and impurity blanks.

There is little doubt that the methods of analysis for zinc, magnesium, and chlorine are so selective that the impurity blank is negligible, and hence the figures obtained approximately represent the true amounts of the constituent. The method of estimating glycerol, however, takes account of any carbonaceous matter reaching the final stage, and depends entirely on the efficiency of the preliminary extraction and separation processes. It is thus quite conceivable that small amounts of polyhydric alcohols analogous to glycerol may not be separated. The raw material blanks given will include any substances which may be soluble in acetone, in alcohol-ether, and in dilute sulphuric acid rather than in light petroleum. An attempt has therefore been made to test the extracts qualitatively for glycerol. The acrolein test and the colour reactions of Denigès[2] have been applied for this purpose to an aqueous extract of the residue from the alcohol-ether distillation, fats being separated by treatment with petrol ether as in the quantitative analysis. For the acrolein test, the solution is heated with solid potassium hydrogen sulphate, the vapours condensed in a cold test tube and treated with ammoniacal silver nitrate. A smell of acrolein and a silver mirror in the cold are obtained if more than one milligram of glycerol be present. The colour tests for glycerol have been carried out as described by Denigès.[2,3] The results are summarised in Table V. for some of the raw materials of sizing.

Table V.—Colour Tests

Material Analysed	Glycerol %. by Combustion	Weight of Glycerol Mgms.	Acrolein	Thymol	β-Naphthol	Resorcinol	Guaiacol	Salicylic Acid	Gallic Acid
Bleached cloth ...	0·03	3·0	—	—	—	—	—	—	—
Raw Sakel yarn ...	0·07	6·7, 7·2	F	Incorrect colour					
Raw American yarn ...	0·11	10·7, 11·0	F	F	F	F	—	F	—
Maize starch	0·05	4·8, 5·0	—	—	—	—	—	—	—
Sago flour	0·19	19·3	F	F	F	F	F	F	F
Wheat flour (mouldy)	—	—	F	+	+	+	+	+	+
Farina starch film ...	Nil	Nil	—	—	—	—	—	—	—
American yarn, sized flour, starch and soap	0·10	10·2, 10·0	+	F	F	F	—	F	—
American yarn, sized maize and tallow ...	0·14	14·4	F	F	F	F	F	F	F
American yarn, sized sago, spermaceti, Japan wax and tallow	0·03	2·7	F	F	F	F	F	F	F
Tallow	0·72	7·2	+	+	+	+	+	+	+

\+ Positive reaction. F Faint reaction. — No reaction.

It appears that the qualitative tests confirm the presence of glycerol or of a substance of very similar chemical behaviour, wherever an appreciable amount is found by the quantitative analysis.

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47—THE DELIQUESCENT PROPERTIES OF MAGNESIUM CHLORIDE, OF CALCIUM CHLORIDE, AND OF GLYCEROL

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INTRODUCTION AND SUMMARY

The deliquescent chlorides of calcium and magnesium find a wide application in the cotton industry as components of sizing and finishing mixtures. Their value lies in their ability to be applied as weighting materials which remain liquid under normal conditions of use and storage of cloth, while it is commonly asserted that they are responsible for the presence of large quantities of water bound by the salts in virtue of their known hygroscopic properties. Though these chlorides are technically unobjectionable in goods which are not subjected to heat in the grey state, they cause dangerous amounts of tendering if they are present in cloth which is singed, or finished by a hot process. On this account glycerol* is sometimes used as a deliquescent in lightly-sized materials, and a question has arisen as to its efficiency as compared with the cheaper salts. In the present paper are recorded measurements on the hygroscopic properties of the three substances, made as a necessary preliminary to a study of their behaviour in textile materials. Some data obtained as a result of an examination of size and sized yarns containing deliquescents are quoted in order to show the necessity for caution in interpreting the measurements made on the pure substances.

The method of experiment has been to make up in sealed vessels successively more and more dilute solutions of the three materials, and after each dilution to observe the pressure of the water vapour in contact with their solutions. The records are given in Table I., not as water vapour pressure, but as percentage relative humidity, i.e., the percentage which the observed pressure is of the maximum possible water vapour pressure (that over pure water) at the temperature of the experiment.

Table I.

Parts of water taken up by 100 Parts of Deliquescent at 20° C.

Substance	Relative Humidity %												
	20	25	30	35	40	45	50	55	60	65	70	75	80
$MgCl_2$	Solid hydrates			178	191	207	222	240	262	283	315	351	413
30% Solution of $MgCl_2$	Loses water							2·0	9·2	15·5	24·5	35·0	53·0
$CaCl_2$	Solid hydrates			140	153	167	182	199	212	245	292	344	413
Glycerol	6·9	9·2	12·3	15·6	19·6	23·5	27·1	31·2	37·4	44·5	53·8	68·1	90·5

*Glycerol is known to the trade as "glycerine."

The series of changes of composition undergone by a mass of magnesium chloride to which water is slowly added is best illustrated graphically (Fig. 2). It is seen that starting with crystalline salt, $MgCl_2 6H_2O$, addition of water can go on until the composition has changed from 46·8% $MgCl_2$ to 35·8% $MgCl_2$ without any change of pressure. The explanation of this is that the first addition of water dissolves a small quantity of the salt, forming a saturated solution. The water vapour pressure of this has a definite value and this pressure must be maintained as long as it is possible for saturated solution to exist, that is until sufficient water has been added to dissolve all the solid. When all the solid is just dissolved, the solution is just saturated and contains 35·8 parts of $MgCl_2$ in 100 parts by weight of solution. The constant relative humidity at which this series of composition changes is possible is 34 per cent. and it is at humidities below this that there appears to be a possibility of magnesium chloride in a fabric crystallising out. As water is added to the saturated solution it gives rise to an increasing pressure of water vapour, expressed in the graph as an increasing relative humidity, as the concentration falls. For calcium chloride, somewhat similar behaviour is encountered, but the possible crystal systems are more numerous and the definition of the composition and humidity of a saturated solution is rather less satisfactory than with the magnesium salt. Glycerol does not crystallise and its graph is one of a smooth change of humidity with concentration.

The graphs are plotted with the composition of the solutions shown as dependent on the relative humidity, and it is from this point of view that the subject is considered in textile practice. It is, however, impossible to assume that the amount of water taken up by a sized cotton material exposed in an atmosphere of a definite humidity is simply the sum of the quantities which would be absorbed by the constituents if they were removed from contact with each other. It is not proposed to discuss the subject at any length, since on account of the difficulty of defining the composition of the material used, it cannot be claimed that the results are very exact, but measurements made on starch and on sized yarn containing deliquescents appear to show that the two chlorides have an inhibiting effect on the absorptive capacity of the materials to which they are applied. A similar inhibiting effect is indicated for glycerol in starch, and the experiments are quoted in order to indicate that no valid claim for the superiority of any deliquescent can be based on measurements made on the pure substances.

The measurements may be of service to those who require to maintain atmospheres of controlled humidity in vessels in the laboratory. The unsaturated solutions of the chlorides or of glycerol may, of course, be used in the same way as are those of sulphuric acid in water[9], and can be as readily checked by observation of their densities, while for biological work they avoid the toxic action which has been attributed to the acid[1]. It must be noted, however, that solutions of glycerol are themselves liable to attack by moulds. Of special interest is the self-controlling univariant system, hydrated magnesium chloride | saturated solution | vapour. If this is made up with such a proportion of salt as will ensure the continued existence of both solid and liquid, no analytical check is necessary, and it is possible to ascertain by inspection that in a vessel containing it the humidity at 20° C. is 34 per cent. An opportunity was taken at the beginning of this work to standardise the apparatus by an observation of the univariant system formed by ammonium nitrate and water, and on account of the convenient

humidity which it determines the value found is given in Table II. It is to be noted, however, that this measurement is merely a repetition of one made by Prideaux[6] who has suggested the use of saturated solutions for stabilising the humidity of air.

Table II.

Relative Humidity at 20° C. over Two Univariant Systems.

Solid Phase	Liquid Phase	Relative Humidty in Vapour Phase (per Cent.)
$MgCl_2 6H_2O$ ...	Saturated solution of $MgCl_2$ ...	34
NH_4NO_3 ...	Saturated solution of ammonium nitrate	64·5

EXPERIMENTAL

Apparatus and Procedure

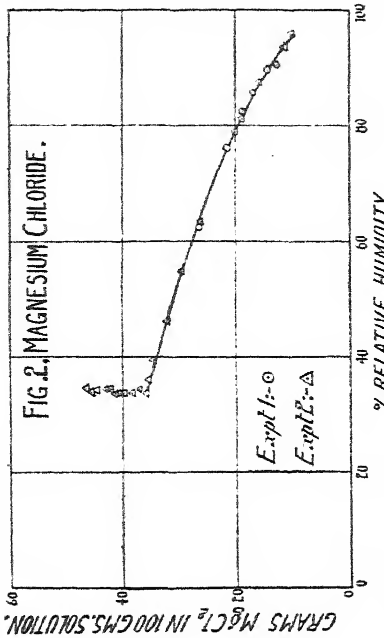
The measurements were made in a number of vessels of the type described elsewhere[3] (*loc. cit.*, Fig. 2). Each of these consists of a bulb of about 50 c.c. capacity, to which are sealed a mercury pressure gauge, and a closed pipette containing air-free water. Into the clean apparatus charged with water, and with its gauge attached, a known weight of material was introduced and the vessel then closed and connected to a vacuum pump. The period of evacuation varied, but was always sufficient to ensure that all air had been removed before the apparatus was sealed. When separated from the pump the whole apparatus was immersed in a thermostat at 20° C., at which temperature all the observations were made. During an experiment a small addition of water would be made to the contents of the bulb by cautious opening of the tap of the graduated pipette, and pressure readings continued from day to day until it was certain that the differences between successive readings were merely chance errors of observation. At this point a new measured charge of water was introduced and the pressure readings repeated. The records of added water and of pressure, combined with a knowledge of the weight and water content of the substance put in the apparatus, clearly provide all the data necessary to construct a composition/vapour-pressure curve for each system considered. The pressures measured are not recorded but are converted to relative humidities by dividing their value in millimetres of mercury by 17·51, the vapour pressure of water at 20° C.

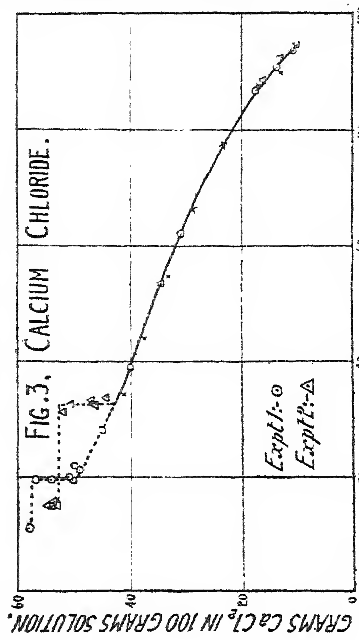
Materials Used and their Manipulation

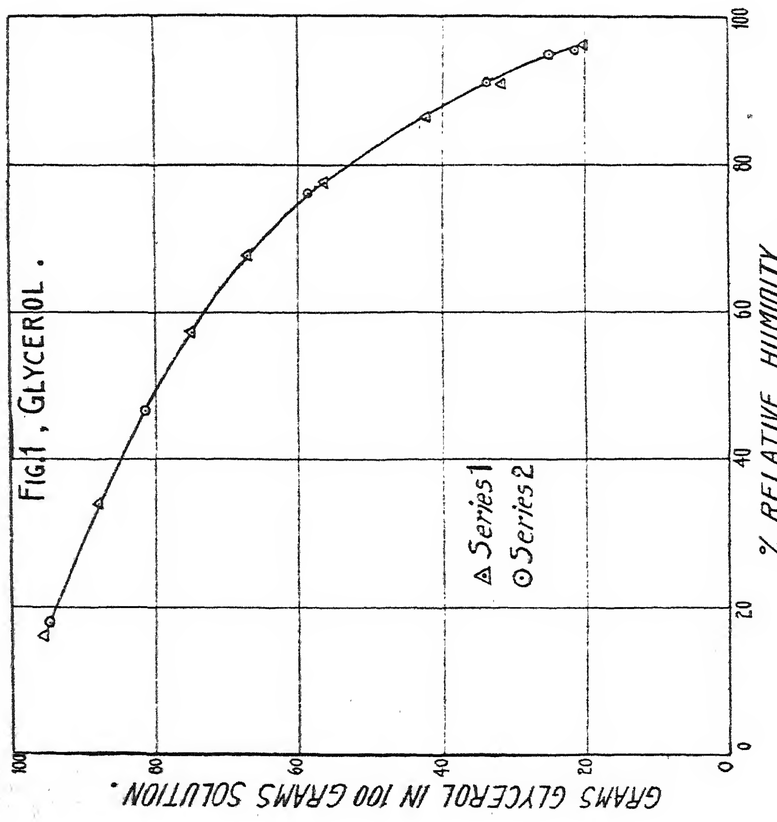
Glycerol.—The material used was medicinal glycerol which had been left in an evacuated desiccator over phosphorus pentoxide for three months. Two determinations were made and the two sets of points lie consistently on the same curve. From determinations of the density of the dilute solution resulting from one experiment, it was ascertained that its concentration was 20·2 per cent., a figure identical with that obtained by considering the weight of glycerol taken (2·263 grams) and the volume of water (8·93 c.c.) added to it.

It was concluded therefore that the glycerol used originally was anhydrous and did not take up an appreciable amount of water before it was sealed in this apparatus.

The experimental values are plotted in Fig. 1 and a smooth curve drawn, from which have been read the figures given in Table I. as part of the summary of the paper.







In Fig. 3 the crosses represent Paranjpé's data

Magnesium chloride.—Well defined dry crystals of the hexahydrate were rapidly transferred to the apparatus, which was immediately closed and evacuated. It was inevitable that the state of the system should be uncertain at the beginning, so no attempt was made to weigh the salt initially. In two series of experiments the final solutions were analysed by a determination of their total chlorine content, and of their concentration, this giving the information shown in the following table—

Table III.

Series	Total $MgCl_2$	$MgCl_2$ in 100 Parts of Solution	Water in Final Solution	Water introduced from Pipette	Water in the Salt at Start of Experiment	
					Grams.	Mols./mol. $MgCl_2$
	Grams.		Grams.	Grams.		
1	1·143	10·06	10·21	9·19	1·02	4·7
2	1·740	13·79	10·88	8·78	2·10	6·4

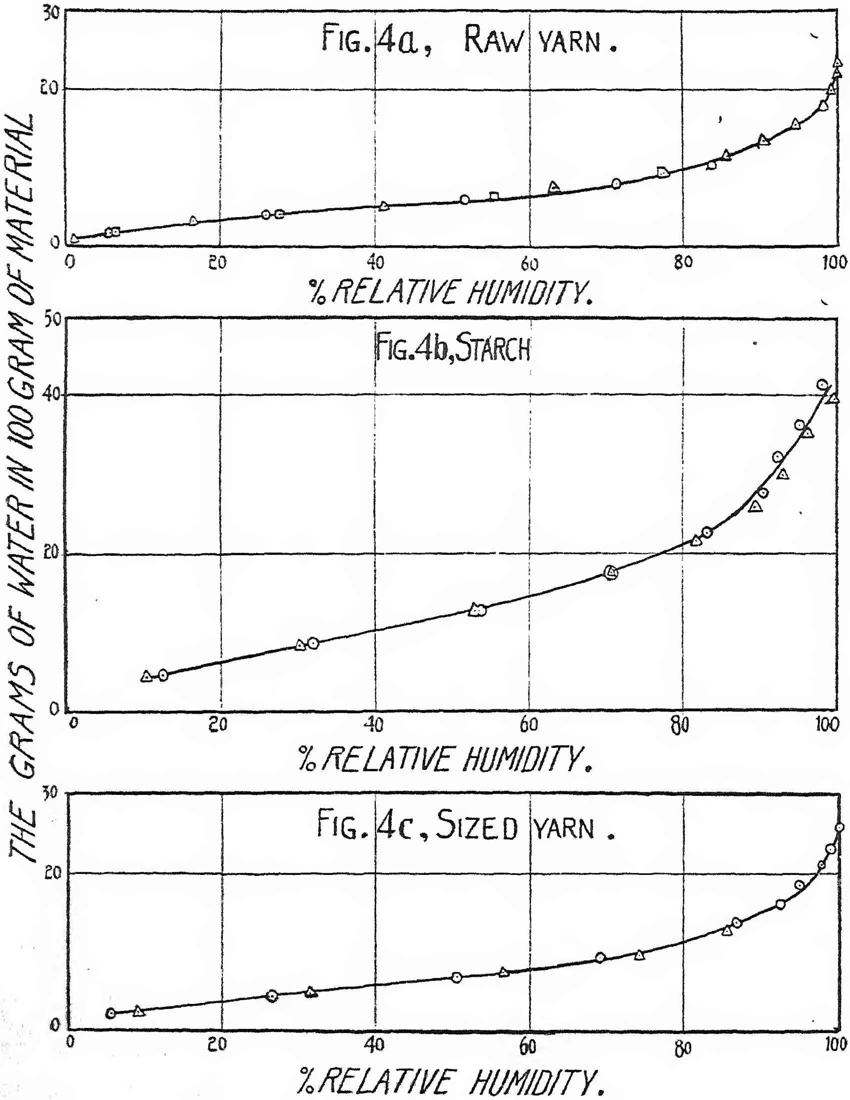
It thus appears that neither experiment began with the magnesium chloride holding the theoretical amount of water associated with the hexahydrate, but when allowance is made for the presence of the quantity ascertained, the data from the two experiments are found to be consistent and to define a curve such as is drawn in Fig. 2, where the two sets of points are distinctively plotted. The vertical portion of the graph shows the constancy of pressure over a saturated solution in contact with the solid salt, and the point where the two lines meet should give the concentration of a saturated solution. Reading from the graph this is found to be 35·8 per cent. of $MgCl_2$ in the solution, whereas Seidell[8] gives 35·3.

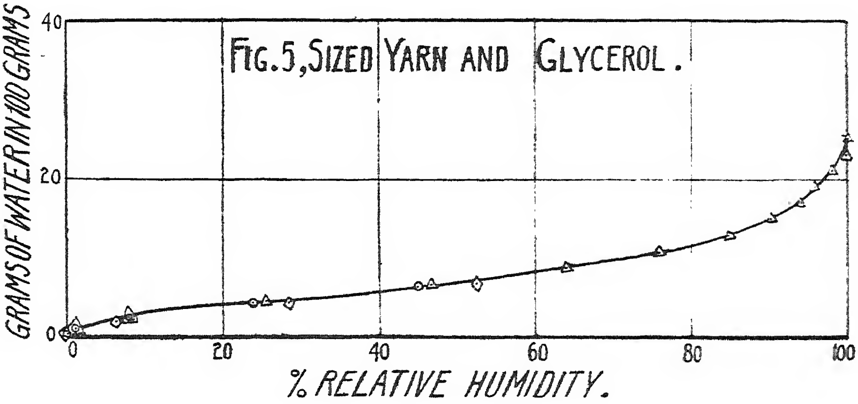
Calcium chloride.—This salt was treated in a similar way to magnesium chloride, the initial composition for two experiments being $CaCl_2.5{\cdot}1H_2O$ and $CaCl_2.4{\cdot}5H_2O$. For the latter the first pressure readings appear to correspond to the metastable system $CaCl_2.4H_2O$—saturated solution (solubility 50·5 per cent.; Roozeboom's[7] value 51·1), while for the other apparatus after an initial low reading the stable univariant system hexahydrate-saturated solution is found to have a vapour pressure of 5·7 m.m. and solubility 42·8 (Roozeboom's values 5·62 m.m. and 42·7 per cent.). The relative humidity over this system is thus 32·5 per cent., whereas Paranjpé[5] states that solid is present at a concentration of 41·2 per cent. with a relative humidity of 34. Apart from this discrepancy the figures now observed agree well with Paranjpé's as is evident from Fig. 3 where they are graphed.

Ammonium nitrate.—In order to test the method of measurement with a well-defined substance, pure ammonium nitrate crystals were employed, being weighed dry into the apparatus. Over a saturated solution a pressure of 11·3 m.m. was observed in agreement with the value given by Prideaux[6].

Starch and Sized Yarn.—Deliquescents were added in known quantity to starch which was evaporated to form films[4] or was applied to yarn. The composition of the starch mixtures was known synthetically, while the final composition of the sized cotton was obtained by removing the size and weighing the purified cotton, due allowance being made for the loss of water-soluble substances from the cotton on desizing. The various materials were dried by a normal process of evaporation, then at 110° C. for two hours and then weighed into the absorption vessel. Subsequent loss of water on

evacuating was ascertained by observing the loss of weight of an exactly similar portion of starch, or yarn, placed in a weighing bulb in connection with the absorption vessel and evacuated with it over phosphorus pentoxide. Assuming the experimental material to have lost weight in the same proportion as the check quantity, it was possible to calculate the weight of "dry" substance in the vessel. That this was absolutely dry may be doubted, but the good correspondence between duplicate determinations which may be seen in the graphs makes it impossible that any important quantity of water remained in the evacuated substance. The bulbs were sealed and water introduced in the usual way, and readings taken over a wide range of humidities. The experimental observations are recorded graphically (Figs. 4 to 8) and only values read from the smooth curves appear in the tables. (Tables IV. and V.)





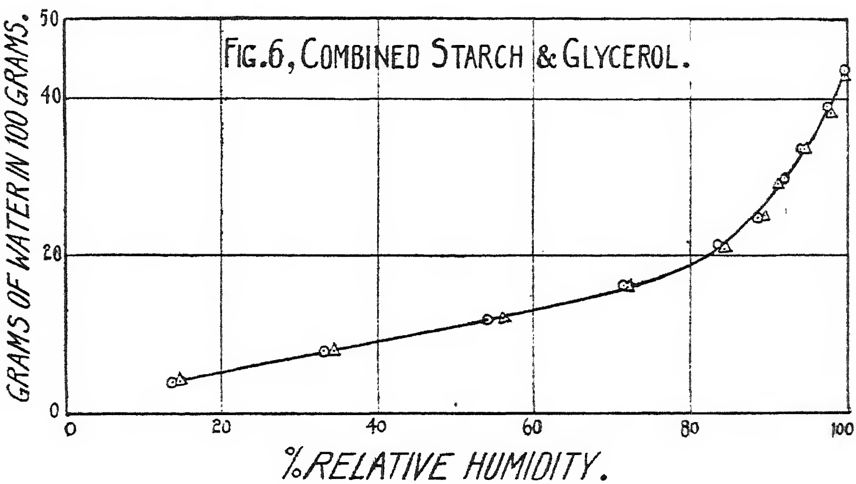


Table IV. shows two sets of values, the unenclosed figures referring to the interpolated readings taken from the graphs, while in brackets are given the amounts of water which would be calculated as the sum of the separate absorptions of the starch and cotton present. For the materials containing deliquescents the companion Table V. shows to what extent the observed value falls short of or exceeds that calculated. If there is a deficiency it appears as if the deliquescent is not only not absorbing water, but is also inhibiting absorption by the starch or cotton, and this is the condition which appears to hold in the region of lower humidity with both magnesium chloride and glycerol in starch. The method of expression is of course entirely arbitrary and a more general view would be that the absorptive capacities of both solid and dissolved substance satisfy each other to the partial exclusion of their calculated charge of water. Even where at higher humidities a positive difference exists, the amount of water is usually considerably less than would normally be taken by the deliquescent, though glycerol on sized yarn is a doubtful exception here.

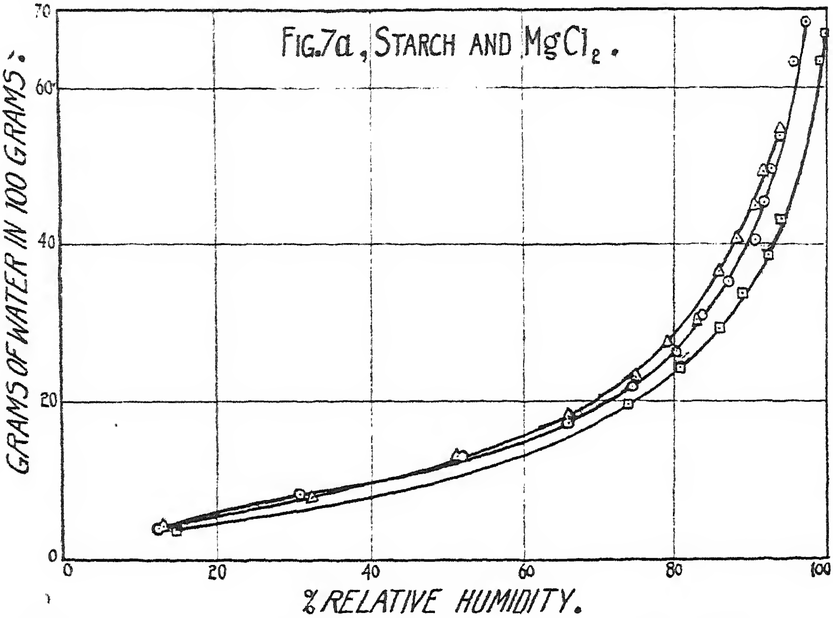


FIG.7a, STARCH AND $MgCl_2$.
GRAMS OF WATER IN 100 GRAMS.
0
20
40
60
70
0
20
40
60
80
100
% RELATIVE HUMIDITY.

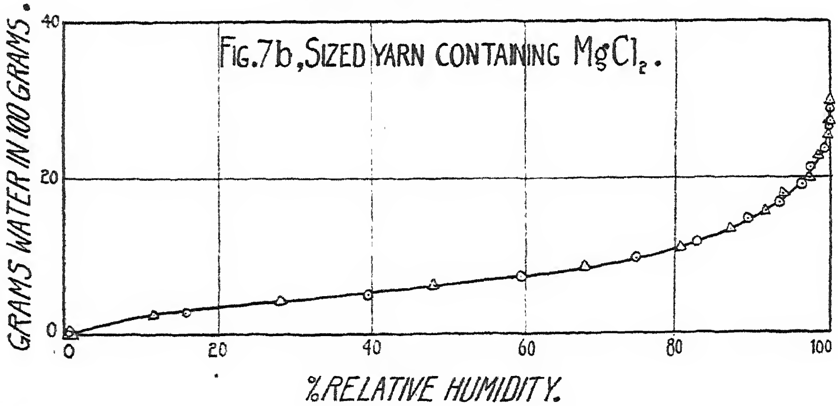


FIG.7b, SIZED YARN CONTAINING $MgCl_2$.
GRAMS WATER IN 100 GRAMS.
0
20
40
0
20
40
60
80
100
% RELATIVE HUMIDITY.

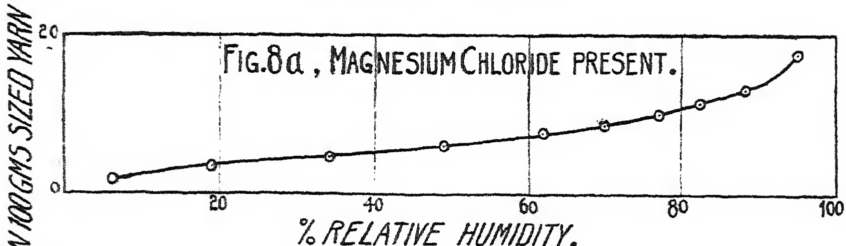


FIG.8a, MAGNESIUM CHLORIDE PRESENT.
0
20
20
40
60
80
100
% RELATIVE HUMIDITY.

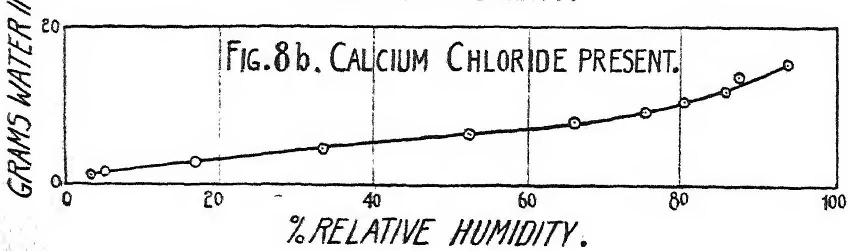


FIG.8b. CALCIUM CHLORIDE PRESENT.
GRAMS WATER IN 100 GMS SIZED YARN
0
20
0
20
40
60
80
100
% RELATIVE HUMIDITY.

Table IV.

Regains of Size and Sized Yarn Found and Calculated (in brackets).

Substance	Composition			Figure	Relative Humidity						
	Cotton	Starch	Deli-quescent		20	30	40	50	60	70	80
Raw cotton	100	—	—	4 (a)	3·3	4·1	4·9	5·7	6·8	8·0	9·5
Starch	—	100	—	4 (b)	6·2	6·2	10·1	12·0	14·3	17·2	20·7
Starch and glycerol ...	—	95·3	4·7	6	5·2 (5·9)	7·2 (7·8)	9·1 (9·6)	11·0 (11·4)	17·0 (13·6)	19·6 (16·4)	23·6 (19·7)
Starch and $MgCl_2$ ...	—	96·9	3·1	7 (a)	5·5 (6·0)	7·9 (7·9)	10·3 (9·8)	12·9 (11·6)	16·1 (13·9)	30·0 (16·7)	28·3 (19·9)
Starch and $MgCl_2$ ...	—	95·2	4·8	7 (a)	5·5 (5·9)	7·6 (7·8)	10·0 (9·6)	12·7 (11·5)	15·4 (13·6)	19·4 (16·4)	26·3 (19·7)
Starch and $MgCl_2$ ...	—	94·4	5·6	7 (a)	5·2 (5·9)	7·1 (7·7)	9·3 (9·5)	12·0 (11·4)	14·5 (13·5)	17·9 (16·3)	23·6 (19·6)
Sized yarn	90·58	9·42	—	4 (c)	3·8 (3·6)	4·7 (4·5)	5·8 (5·4)	6·9 (6·3)	8·0 (7·5)	9·2 (8·9)	10·9 (10·5)
Sized yarn and glycerol	92·7	6·95	0·35	5	3·6 (3·5)	4·5 (4·4)	5·7 (5·3)	6·7 (6·1)	7·9 (7·4)	9·5 (8·7)	11·5 (10·4)
Sized yarn and $MgCl_2$ ...	93·3	6·32	0·33	7 (b)	3·4 (3·5)	4·3 (4·3)	5·2 (5·2)	6·3 (6·1)	7·4 (7·2)	8·8 (8·5)	10·8 (10·2)
Sized yarn and $MgCl_2$ ...	91·1	7·56	0·75 Remainder tallow	8 (a)	3·4 (3·5)	4·2 (4·4)	5·1 (5·2)	6·1 (6·1)	7·3 (7·2)	8·5 (8·6)	10·9 (10·2)
Sized yarn and $CaCl_2$ ...	92·1	6·78	0·68 Remainder tallow	8 (b)	3·2 (3·5)	4·3 (4·3)	5·3 (5·2)	6·3 (6·1)	7·4 (7·2)	8·6 (8·5)	10·4 (10·1)

These observations are put forward with some reserve, but they are held to indicate that the addition of a soluble salt to size does not necessarily increase the percentage of water taken up by sized yarn. The weighting effect of salts, on this view, is exerted by their simple presence rather than by their capacity for attracting water, while their power of influencing favourably the mechanical properties of yarn may well be due to quite different causes from those usually assumed.

Table V.

Apparent Effect of Deliquescent in Increasing or Diminishing the Water taken up by Cotton and Starch.

Relative humidity, %	20	30	40	50	60	70	80
Substance—Composition as in Table IV.	Parts of water gained or lost						
4·7 parts glycerol in starch	−0·7	−0·6	−0·5	−0·4	+3·4	+3·2	+3·9
0·36 ,, glycerol in sized yarn ...	—	—	+0·4	+0·6	+0·5	+0·8	+1·1
3·1 ,, $MgCl_2$ in starch	−0·5	—	+0·5	+1·3	+2·2	+3·3	+8·4
4·8 ,, $MgCl_2$ in starch	−0·4	—	+0·4	+1·2	+1·8	+3·0	+6·6
5·6 ,, $MgCl_2$ in starch	−0·7	−0·6	—	+0·6	+1·0	+1·6	+4·0
0·33 ,, $MgCl_2$ in sized yarn ...	—	—	—	—	—	+0·3	+0·6
0·75 ,, $MgCl_2$ in sized yarn ...	—	—	—	—	—	—	+0·7
0·68 ,, $CaCl_2$ in sized yarn ...	−0·3	—	—	—	—	—	+0·3

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48—THE ABSORPTION OF WATER BY DRIED FILMS OF BOILED STARCH

ABSORPTION AND DESORPTION BETWEEN 20° C. AND 90° C.

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INTRODUCTION AND SUMMARY

In an earlier paper[1] it was shown that a graph of the "regain" of dry starch which is brought into successively more and more humid atmospheres is an S-shaped curve showing a rapid initial absorption at low humidities, a more gradual increase in the range from 20 per cent. to 80 per cent. relative humidity, and a very considerable increase in the amount absorbed as saturation is approached. An account is now given of experiments dealing with this absorption at higher temperatures than those previously employed, while the different final result (hysteresis) of bringing dry or wet starch into any given atmosphere is also examined over a fairly wide temperature range.

The general slope of the absorption curve at 20° C. is confirmed and a second curve is obtained when starch saturated at this temperature is brought back to dryness by a gradual process of removal of water by exposure in increasingly dry enclosures. This (desorption) curve is similar in shape to the absorption curve but lies above it (when regain is the ordinate), so that at any relative humidity starch may exist in one of two extreme states which differ in their water content according as the material has been brought from a state of dryness or from saturation, to the atmosphere in which it is observed. The maximum regain at any humidity is given by a point on the desorption curve, and the minimum by an equally well-defined point on the absorption curve which leads from dryness to saturation.

The above statement summarises the knowledge attained by consideration of the previous paper[1] and part of the present work. The phenomenon of hysteresis is more concretely illustrated by the figures (Table I.) showing the order of the difference of water content according as an upward or downward path of wetness is followed, the arrows showing the sequence of exposure. It must be understood that each of the figures quoted represents a steady state of the wet starch, which will not gain or lose water by further exposure to the humidity against which the regain figure stands.

Table I.

Parts of water to 100 parts of dry starch.

Relative humidity (per cent.)	0	20	30	40	50	60	70	80	100
Absorption ⟶	0	6·7	8·6	10·4	12·2	14·2	16·3	19·0	⟶ ↓
Desorption ⟵	0	8·0	10·3	12·7	14·9	17·2	19·5	22·2	⟵

These figures are for a particular sample of starch film evaporated at 70° C., but another specimen prepared at 100° C. and tested at the same time gave desorption figures appreciably higher than those in the table, and it is clear from these and other experiments that the retentive power of a starch film is greater the higher the temperature or the more prolonged the period of heating of its original preparation.

Absorption and Desorption at Temperatures above 25° C.

Direct determination of absorption at 30° C. showed that at the same relative humidity but at higher temperatures less water was taken up. Other experiments on the effect of temperature were conducted by measuring the pressure over the system at a series of temperatures by the method used on cotton by Urquhart and Williams[2]. Some of the experiments were made by adding water to dry starch and others by withdrawing water from the saturated material, so that observations were obtained which gave points on both absorption and desorption curves at various temperatures. Using a method of interpolation, which is described elsewhere[2], the data were employed in the construction of absorption and desorption isotherms at various temperatures. With regard to the former, measurements at high temperature suffer in accuracy from the sensitiveness of starch to heat, so that it is difficult to be certain that the same material was being experimented on at 90° C. as at the lower temperatures. Subject to this limitation the sheaf of the absorption curves obtained gives evidence of a similar behaviour to those obtained with cotton by Urquhart and Williams[2]. The decreased absorption noted at 30° C. as compared with 20° C. is reproduced by a further decrease for each successive step in temperature, except that at humidities above 80 per cent. there is a crowding together of the curves with a suggestion that the high temperature curves if continued would cross those of low temperature. It is unfortunately impossible, owing to experimental irregularities, to deal with any accuracy with the effects of high temperatures. The desorption isotherms obtained by a similar process are determined for a rather narrow range of humidities but they serve to show that the difference between the absorption and desorption value at any humidity is less the higher the temperature, so that at 90° C. there is no certainty that this hysteresis exists at all. At 20° C. the absorption and desorption curves obtained by the indirect method agree fairly well with those directly determined as the following table shows—

Table II.

		Regains at the relative humidities shown (Direct and Indirect methods).								
Relative humidity % ...		0	20	30	40	50	60	70	80	100
Direct	Absorption ...	0	6·7	8·6	10·4	12·2	14·2	16·3	19·0 →	
	Desorption ...	0	8·0	10·3	12·7	14·9	17·2	19·5	22·2 ←	
Indirect	Absorption ...	0	6·7	8·5	10·2	11·9	13·8	16·2	19·0 →	
	Desorption ...	0	8·7	10·7	12·8	15·0	17·4	19·5	22·3 ←	

It is not proposed to suggest any applications of these measurements at this stage. The work as conducted has been remote from practice but will conceivably be of utility in the future in investigations dealing more explicitly with the behaviour of starch-filled goods undergoing treatment at varying temperatures and with a wide variety of water contents.

EXPERIMENTAL

Desorption Isotherms at 20° C.

Experiments C, D, E, and F of the previous paper[1] were continued by exposing the weighing bottles containing the starch samples over water for some time, and then again in desiccators over sulphuric acid of the requisite concentration to control the atmosphere at the different stages of decreasing humidity desired. The complete results are given in Tables III. and IV., and those for experiments D and F are plotted in Fig. 1, the others being omitted in order to avoid confusion of the graph.

Table III.

Experiments C and E; desiccator experiments in the presence of air.

C	R.H.	23·8	25·3	46·8	47·7	73·2	73·2	100	73·3	73·1	47·8	47·6	24·6	24·0
	Regain	6·9	7·2	11·6	11·3	17·5	17·5	—	20·6	20·4	14·1	14·0	9·0	9.0
E	R.H.	23·8	24·5	47·3	47·3	72·8	72·9	100	73·2	72·9	47·6	47·6	23·6	23·6
	Regain	6·5	6·9	11·6	11·9	17·3	16·7	—	21·6	20·7	15·2	15·1	9·5	8·8

——Absorption——→ ——Desorption——→

In this and subsequent tables "R.H." indicates percentage relative humidity and "Regain" the weight in grams of the water held by 100 parts of dry starch.

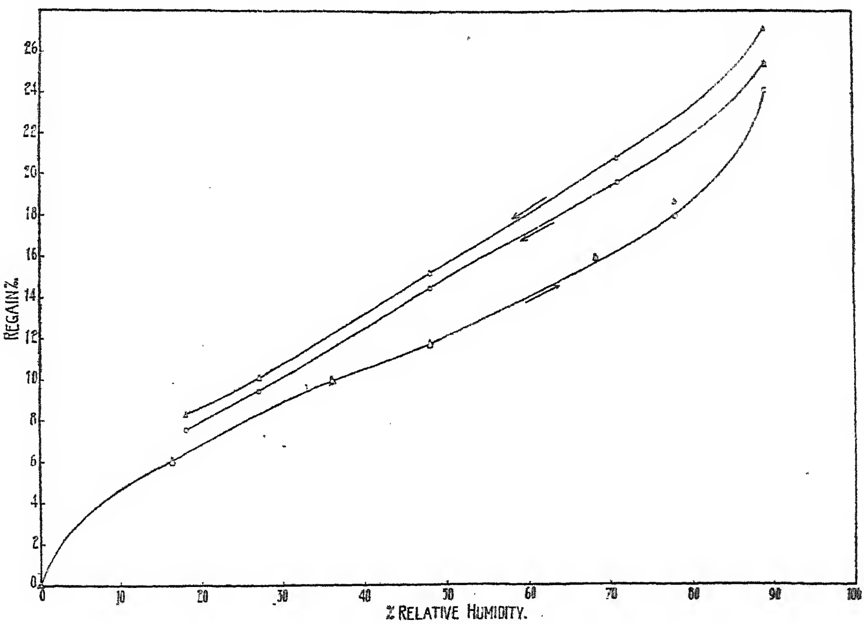

FIG. 1

Table IV.

Experiments D and F; desiccator experiments under reduced pressure (16 mm.)

Exp.	R.H.	0	16·4	35·8	47·8	68·3	78·0	89·2	100	89·2	70·9	47·8	27·0	18·2
D	Regain i.	0	5·8	9·3	11·5	15·8	17·9	23·9	?	25·2	19·4	14·4	9·4	7·6
	,, ii.	0	6·1	9·6	11·9	16·0	18·0	24·2	?	25·5	19·7	14·5	9·5	7·6
	Mean ...	0	6·0	9·5	11·7	15·9	18·0	24·1	?	25·4	19·6	14·5	9·5	7·6
F	Regain i.	0	6·1	9·5	11·8	16·2	18·8	25·4	?	27·4	21·2	15·6	10·5	8·6
	,, ii.	0	6·1	9·5	11·7	15·8	18·5	25·4	?	26·7	20·3	14·7	9·7	7·9
	Mean ...	0	6·1	9·5	11·8	16·0	18·7	25·4	?	27·1	20·8	15·2	10·1	8·3

——————Absorption————→ ———Desorption———→

It will be seen that though the absorption curves for the two experiments coincide there are two desorption curves, that for experiment F (and for E which is not plotted) lying above the other. The films for C and D were evaporated at 70° C., those for E and F at 100° C., and it appears that the higher temperature used in the preparation of the latter makes them more retentive of water than are those prepared at the lower temperature.

In addition absorption and desorption values given by different samples of starch treated according to the scheme indicated in Table V. give evidence of the existence of hysteresis at 20° C. at humidities as low as 8 and as high as 96·5 per cent.

Table V.

Hysteresis at high and low humidities.

Sample		Sequence of exposure. (1)	(2)	(3)	(4)
A ...	Relative humidity	0	8·2	100	8·5
	Regain...	0	4·0	—	6·1
B ...	Relative humidity	0	96·5	100	96·5
	Regain...	0	36·1	—	37·1

The conclusion that the hysteresis of a starch film is the greater the more it has been heated is supported by experiments on materials prepared in a variety of ways, and typical results are given in Table VI. The time and temperature of drying refer to the treatment employed to bring the starch into the film form, and in all cases it was necessary to complete the process by prolonged drying over phosphorus pentoxide in vacuo. The experiments were conducted in the usual way with desiccators, exposing the starch in weighing bottles, and weighing from time to time until constancy was attained.

Table VI.

Regain and hysteresis of starch film evaporated by different processes.

Method of evaporation	Humidity sequence 52	→68	→100	→68	Hysteresis at 68% R.H.
In vacuo over sulphuric acid	14·8	18·0	(40·1)	21·2	3·2
At 75° C. for 24 hours	12·9	16·1	(39·6)	20·3	4·2
At 110° C. for 24 hours	12·6	16·0	(38·7)	20·9	4·9

The change of hysteresis here is mainly dependent on the known effect of heating in reducing the absorptive power of starch[1], further evidence on which is afforded by experiments done by the volumetric method and tabulated below.

Table VII.

Regain of starch film evaporated by different processes.

Method of Evaporation	R.H.— 45·0	55·0	65·0	75·0	85·0
48 hours over P_2O_5 at 18° C.... ...	12·9	14·7	16·6	—	—
$2\frac{1}{2}$ hours at 80° C. in air	12·2	14·1	16·0	18·5	22·2
20 hours at 100° C. in air	11·4	13·2	15·4	17·8	21·1

Absorption at 30° C.

An isotherm at this temperature was determined in the usual way by the volumetric method[1], known quantities of water being introduced into an evacuated vessel containing starch, and the pressure noted. The experiment is recorded in Table VIII. and graphically in Fig. 2, and some use is made of interpolated values at a later stage. Compared with the 20° C. isotherm which is plotted alongside it the absorption at 30° is less at any given humidity throughout the range investigated.

Table VIII.

Absorption isotherm at 30° C.

R.H. ...	9·5	26·8	44·8	59·3	67·8	86·4
Regain...	4·0	7·7	10·7	13·5	15·5	21·1
Starch sample	A	A	A	B	A	B

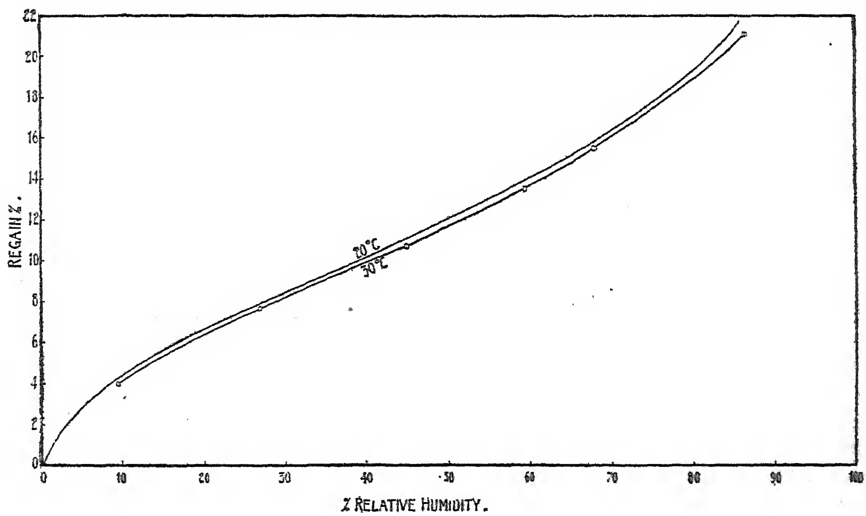

FIG. 2

Absorption and Desorption Isotherms at Higher Temperatures

The method of experiment employed for this section of the work was almost identical with that described by Urquhart and Williams[2] and it is

Table IX.

Vapour pressure over moist starch in evacuated vessels at various temperatures.
a=Regain (per cent.); p=vapour pressure.

Apparatus	A		B		C		D		E		F		G		H	
	Absorption		Absorption		Absorption		Absorption		Absorption		Desorption		Desorption		Desorption	
Temperature	a	p	a	p	a	p	a	p	a	p	a	p	a	p	a	p
20° C.	4·0	1·5	8·5	5·4	12·3	9·2	20·0	14·2	26·1	16·7	8·0	2·9	13·1	7·5	20·2	12·5
25° C.	4·0	1·9	8·5	7·4	12·2	13·0	19·9	19·4	26·1	22·3	8·0	4·4	13·1	10·7	20·1	17·7
30° C.	4·0	2·3	8·5	10·6	12·2	17·5	19·9	26·2	26·0	29·5	8·0	6·6	13·1	15·0	20·1	24·6
40° C.	4·0	4·2	8·4	19·5	12·2	32·0	19·9	41·8	26·0	50·4	8·0	13·5	13·0	29·3	20·0	45·3
50° C.	4·0	7·9	8·4	34·8	12·1	54·9	19·8	78·6	26·0	84·3	7·9	26·3	13·0	53·4	19·9	78·5
60° C.	4·0	14·1	8·3	61·2	12·1	93·5	19·6	128	25·8	140	7·9	49·1	12·9	94·8	19·8	130
70° C.	3·9	24·6	8·3	101	11·9	152	19·4	201	25·8	219	7·8	84·2	12·7	158	19·5	206
80° C.	3·9	40·3	8·2	162	11·6	239	19·2	304	25·6	331	7·7	138	12·5	247	19·2	309
90° C.	3·8	66·9	8·0	242	11·3	352	—	—	—	—	7·5	218	12·3	—	—	—
80° C.	—	40·5	—	163	11·6	239	—	—	—	—	—	146	—	255	—	—
70° C.	—	24·5	—	105	11·9	157	—	—	—	—	—	94·0	—	169	—	—
60° C.	—	14·2	—	64·5	12·1	99·2	—	—	—	—	—	56·5	—	105	—	—
50° C.	—	8·1	—	37·9	12·1	59·4	—	—	—	—	—	32·5	—	62·5	—	—
40° C.	—	4·7	—	21·5	12·2	34·4	—	—	—	—	—	17·9	—	35·5	—	—
30° C.	—	2·7	—	12·0	12·2	19·2	—	—	—	—	—	9·7	—	19·1	—	—
25° C.	—	—	—	8·9	12·2	13·9	—	—	—	—	—	—	—	—	—	—
20° C.	—	1·5	—	6·6	12·3	10·5	—	—	—	—	—	4·8	—	10·0	—	—

Reading down the columns the experiments are recorded in the order in which they were made.

therefore unnecessary to give any detailed account of it. Briefly, it consists in introducing a known weight of dry starch into an absorption vessel to which a gauge is sealed, admitting a definite amount of water to the evacuated space, and sealing the apparatus. For investigation of desorption a known excess of water was admitted, and a weighed quantity removed by means of a phosphorus pentoxide bulb before the apparatus was closed.

All heating was done in water thermostats, so that 90° C. was the highest temperature at which observations were made. Observed differences of mercury level were corrected for temperature, and allowance was made for the amount of water vapour in the free space, the corrected experimental figures being given in Table IX.

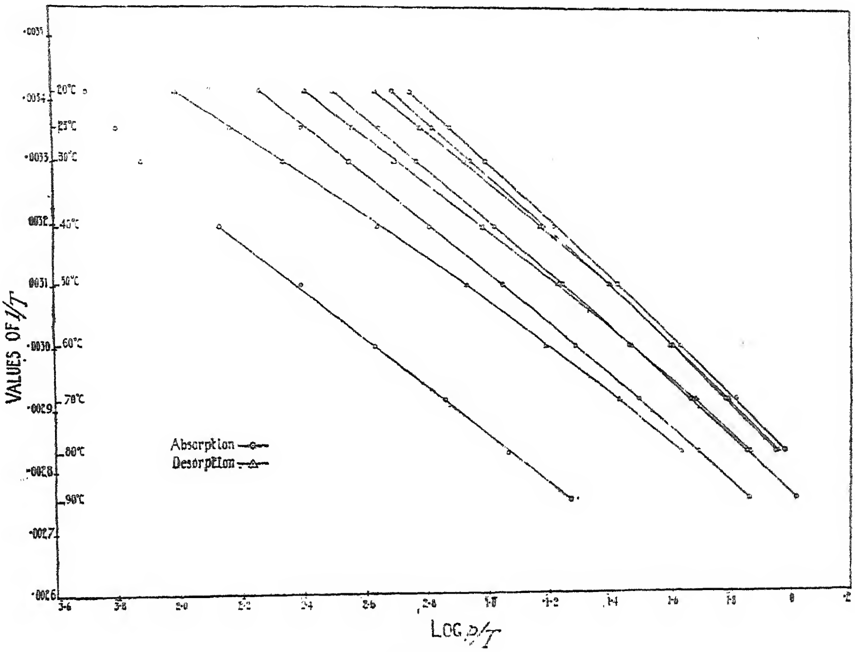

FIG. 3

It will be seen that where the absorption vessel after heating to its highest temperature was taken down stage by stage to 20° C., the pressure at the second passage of any temperature was considerably higher than the initial reading. This accords well with other observations that prolonged heating causes starch to lose some of its capacity for absorbing water, but it unfortunately renders it probable that the high temperature readings refer to a material whose properties have changed since the low temperature observations were made. There is no certain means of improving the significance of the figures which result from this type of experiment, and the data which are employed are those obtained from the first readings with the temperature rising. In the vessels where desorbing film was observed the divergence between the initial and final low temperature readings is more considerable than in the absorption vessels. This is to be expected, since the water lost owing to the diminished hygroscopicity at the higher temperature cannot be reversibly restored to the starch as it should be if an absorption curve were being considered.

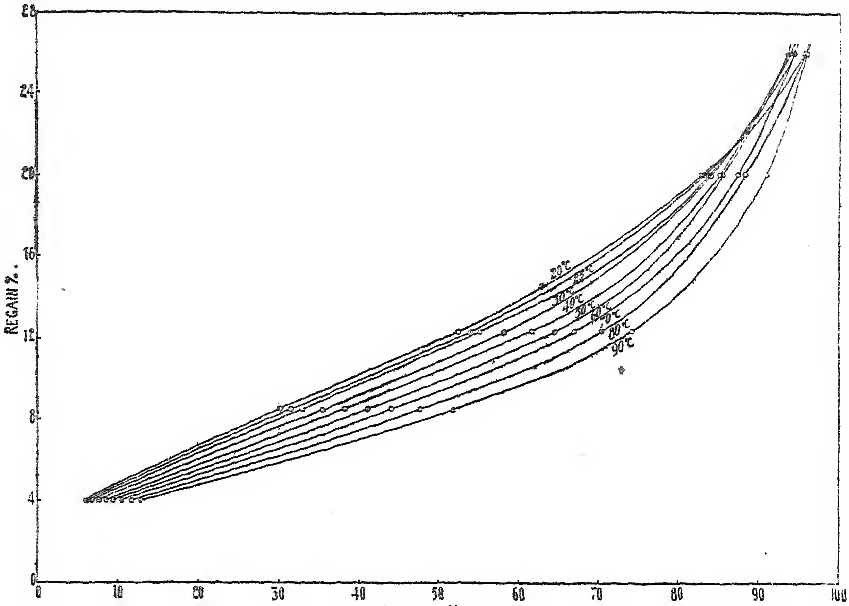

FIG. 4 (Absorption)

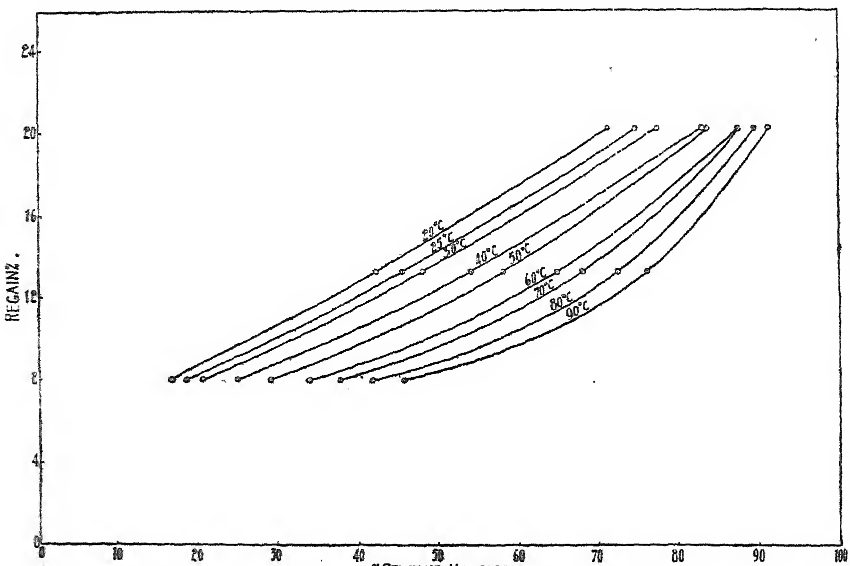

FIG. 5 (Desorption)

From the pressure and regain figures (p and a) of Table IX., isothermal curves were plotted, and from these were read off values of the pressure corresponding to the series of regains which defined the condition of the starch originally put into each apparatus. These initial isotherms were used merely for the purpose of correcting by a short extrapolation for the loss of water into the vacuous space as the temperature of the separate vessels was raised. The new set of figures consists, therefore, of eight series defining the relation between pressure and temperature, at constant water content, and from these, eight isosteres, or curves of equal regain, are plotted in Fig. 3. The graphs are those of $1/T$ against $\log p/T$ (T is absolute temperature, p is the vapour pressure of the starch/water system), following Urquhart and Williams[2], and it will be seen that they approach very closely to the straight lines which are to be expected from Williams'[3] theoretical treatment. Actually as in the case of cotton, the lines are slightly curved and have been drawn so, being used as the most suitable means of smoothing out irregularities of the experimental data. All have been extrapolated where necessary to 90° C., though this does not appear in the figure, and that for apparatus A to 20° C., since it seems probable that the lowest three points here are subject to some error, possibly on account of the difficulty of correcting adequately for the height of the meniscus in the pressure gauge at the lowest temperatures. Reading from these curves, and converting pressures to relative humidities, a new series of smoothed values is obtained relating regain to humidity at the various temperatures, and these are expressed graphically for absorption in Fig. 4 and desorption in Fig 5.

There are two possible checks on the validity of the methods employed, consisting in a comparison of the values at 20° C. and 30° C. obtained by this indirect method and by direct weighing or measurement at each point. The former comparison is shown in Table II. in the introduction to this paper, the 20° desorption isotherm in Fig. 5 having been extrapolated to widen the range of comparison. The figures at 30° C. are available for absorption only and are given below—

Table X.

Regains at 30° C.

R.H.	20	30	40	50	60	70	80
Direct Method	6·4	8·3	9·9	11·7	13·6	16·1	18·9
Indirect method	6·3	8·0	9·7	11·4	13·2	15·3	18·3

The differences between the regains given for the different experiments are no greater than are found between any two specimens of starch evaporated and dried at different times, and it is unfortunately impossible to regard any stated regain as having a less uncertainty than 5 per cent. of its value.

On this account the isotherms of Figs. 4 and 5 are of qualitative interest only, since it is improbable that they define the water content at any stage of an industrial process, of starch occurring in yarn or fabric. It is clear that at low and moderate humidities starch becomes less hygroscopic as the temperature is raised. It seems probable that as the humidity approaches 90 per cent. the high temperature isotherms cross those for low temperature so that at these high humidities starch is more hygroscopic at high than at low temperatures. This behaviour is similar to that observed for cotton[2], and whatever explanation is advanced for the phenomenon must be capable of application to the widely different types of structure possessed by evaporated starch pastes, and the mechanically intact cotton hair.

With regard to hysteresis it is seen that the gap between the absorption and desorption curves is wide at low temperatures but almost disappears at 90° C. It would be premature to speculate as to the practical significance of this for the conduct of any industrial drying process, since the experimental path has necessarily been one which is not traversed by material following the more complicated sequence of works treatments. It can only be suggested that the present results may be of some value as a guide to the phenomena to be looked for in some futuıe examination of the sizing and finishing of cotton goods.

Acknowledgment is made of the help of Mr. E. Bradbury in the experimental work.

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49—THE IMPORTANCE OF HAIR WEIGHT PER CENTIMETRE AS A MEASURABLE CHARACTER OF COTTON AND SOME INDICATIONS OF ITS PRACTICAL UTILITY

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INTRODUCTION

It has already been shown that defects in yarns or fabrics may be due to factors which are inherent in the irregularity of the raw material, and which consequently lie outside control during a mechanical process.[14] This irregularity is reflected in the variability in the measurable characters of the single cotton hairs, the chief of these being length, width, strength, thickness of cell wall, and hair weight per centimetre. The range of variation in certain of these characters has also been shown.[1,5,7,8,13]

The present paper is an attempt to demonstrate the importance of one of these characters—hair weight per centimetre—both in relation to the quality of cottons and also as a means of assisting in their identification, more particularly when in the form of yarn or fabric.

Many text-books [2,3,11,12,16] dealing with textile fibres, give values for some of the measurable characters of cotton, but do not include hair weight per centimetre. Balls[2] first sketched a method of obtaining it by means of a torsion balance; while Clegg and Harland determined this quantity for five different cottons with no reference, however, to its practical application.[7] Balls[2] regarded the weight of the hair, depending as it does upon its width and thickness of its cell wall, as equivalent to its strength, and stated that "the breaking strain of a fibre is very largely determined, if not entirely, by its own weight, or, in other words, by the thickness of its cell wall." Burd[4] employed a torsion microbalance with a fine glass fibre in an attempt to determine the number of hairs on a single cottonseed; and, later, in a variety test of a number of pure strain Sea Island cottons he came to the conclusion from the results of spinning tests that "there appears to be no relation between the hair strength and the weight of single hairs." Denham[10] has described a method for the construction of a simple torsion microbalance for weighing cotton hairs. A modified balance of this type has been employed during the present investigation, and is described, together with the technique of sampling and weighing, in the Appendix.

RESULTS OF ROUTINE MEASUREMENTS

Preliminary tests were carried out on Sea Island, Texas, and Broach cottons at different stages of cardroom preparation, with the results shown in Table I.

Table I.

Hair Weight per Centimetre.*

	Sea Island	Texas	Broach
Mixing	—	202	252
Finisher lap	109	199	—
Card sliver	107	200	251
Comber sliver	107	—	—
Finisher sliver	—	200	—
Roving	107	—	—

There is no indication of fractionation by weight throughout the various processes, and presumably coarse hairs are just as liable to be broken as fine ones, since if it were otherwise a change in value would be expected after carding and combing. The useful practical issue of this is that the mean value for any given mixing may be found by sampling from cotton at any one of the cardroom processes, where the hairs have already been thoroughly well mixed and parallelised.

With a view to obtaining some idea of the range of weight within a given variety, tests were then made on random bales from the stocks of three mills using Texas, Sakel, and Uppers cotton respectively.

In the case of the Texas cotton, two bales of each of seven marks were at the time being put through separately to determine their relative spinning values. Tests were made, therefore, not only from the bale, but also from the slubbing, presuming that the latter is more likely to furnish an accurate average value for the bale, having been doubled 864 times in preceding processes. The results are given in Table II.

Table II.

Hair Weight per Centimetre.

Mark	Bale No.	From Middle of Bale	From Slubbing
A	1	196	204
	2	175	172
	3	182	—
B	1	207	209
	2	176	176
	3	209	—
C	1	187	196
	2	193	185
	3	193	—
	4	186	—
	5	167	—
D	1	186	196
	2	194	196
E	1	207	210
	2	190	191
F	1	171	176
	2	192	194
	3	207	—
	4	209	—
G	1	197	199
	2	196	201

From these figures two conclusions may be drawn.

(1) A sample taken from the middle of the bale does not necessarily represent the whole, but may differ by as much as 4½% from the slubbing figure, which may be taken as most truly representing the bulk. Further

* Throughout this paper hair weight per cm. values will be quoted in mgms. $\times 10^{-5}$, i.e., 0·00001 mgm.

investigation confirmed this conclusion. Two bales, one of mark A and one of C, were taken at random, and tests made on samples from the top and from the bottom in each case. The results were as follows—

Hair Weight per Centimetre.

Mark		Top of Bale		Bottom of Bale
A	...	196	...	197
C	...	185	...	165

Thus, although the bale from mark A appeared to be uniform throughout, the bale from mark C showed that within one bale two samples taken from different parts of it might differ by as much as 10%.

(2) The variation from bale to bale in a given mark was found to be as great as that from mark to mark, and consequently it was impossible to assign any characteristic hair weight per cm. value to any given mark. From the bale figures for mark C it will be seen that the range is 167-193, which almost covers the range for all tests, viz., 167-209. This great variation is to be expected when it is considered that the industrial supply is drawn from a large area covering considerable variation in general growing conditions and cultivation. Owing to present marketing methods, cotton from any one grower (or group of growers) has generally lost its identity by the time it reaches the spinner, and the marks under which the latter buys it seldom bear any relation to the exact locality of origin. Consequently the question as to whether any mark can be relied upon to maintain a consistent quality depends entirely on the grader's judgment. This point can be emphasised by pointing out that the difference in fineness between two bales of Texas cotton of the same grade and staple length may, on occasion, be greater than that found between a good Sakel and a Sea Island cotton.

Results of similar tests carried out on Uppers and Sakel cottons are given in Table III.

Table III.

Hair Weight per Centimetre.

Cotton		Mark		Top of Bale		Bottom of Bale
Sakel	...	H	...	127	...	127
	...	J	...	131	...	134
	...	K	...	123	...	—
	...	L	...	126	...	—
	...	M	...	128	...	—
	...	N	...	128	...	—
	...	O	...	128	...	—
	...	P	...	129	...	—
Uppers	...	Q.1	...	187	...	173
	...	Q.2	...	177	...	178
	...	R	...	182	...	180

Although these observations may be too few to justify definite conclusions, they indicate, nevertheless, that in Egyptian cotton there is not such an extensive range of variation within one year's crop as in American. This is no doubt partly due to the much more uniform growing conditions that prevail in the Egyptian cotton areas.

In Table IV. is given a list of hair weights per cm. for 127 samples of cotton covering a wide range of varieties.

It will be seen that there are no definite dividing lines between the values for the main types of cotton, and that the range of each type is very considerable, as follows—

Sea Island	102—136
Sakel	113—151
Assili	144—170
Uppers	177—212
Texas	167—211
Indian	193—312
Indian American	145—226
African American	135—180

These figures are not intended to indicate the maximum range for the various types mentioned, since in most cases there have been only a few samples tested, but merely give the ranges so far observed.

Table IV.

Sample No.	Cotton	Hair Weight per cm. Mgms. $\times 10^{-5}$	Staple Length mm.	Mercer-ised Diam. μ	Wall Thickness μ
	Sea Island				
327	St. Vincent	126	—	—	—
329	Tortola	118	—	—	—
326	Barbados	108	—	—	—
—	Porto Rico	114	—	—	—
328	Antigua...	121	—	—	—
330	Montserrat	136	—	—	—
29	Mill sample	112	44·3	11·50	3·25
331	Fiji	102	—	—	—
332	Gold Coast	108	—	—	—
	Egyptian				
H	Sakel—Mill sample	127	—	—	—
J	,, ,, ,, ...	131	—	—	—
K	,, ,, ,, ...	123	—	—	—
L	,, ,, ,, ...	126	—	—	—
M	,, ,, ,, ...	128	—	—	—
N	,, ,, ,, ...	128	—	—	—
O	,, ,, ,, ...	128	—	—	—
P	,, ,, ,, ...	129	—	—	—
S	,, ,, ,, ...	151	—	—	—
64	Sakel	132	38·5	—	3·70
202	,, F.G.F.	144	35·2	—	—
198	Sakel X (Domains)	136	38·0	11·79	—
407	,, X (Domains)	146	37·0	12·24	—
201	,, C/23 (Domains) ...	133	37·2	11·71	—
408	,, C/23 (Domains) ...	146	37·0	11·88	—
382	,, S.1	148	37·0	12·06	—
383	,, S.2	113	36·4	11·33	—
385	,, S.4	113	36·5	11·36	—
200	"310" X (Domains)	133	37·7	12·10	—
409	,, (Domains)	128	37·5	11·61	—
127	Jannovitch	138	39·5	12·24	—
199	Assili N/22 (Domains) ...	144	36·2	12·12	—
410	Nahda 24	159	33·3	12·62	—
411	Nahda 22/X	170	32·3	12·54	—
132	Pilion	178	—	—	—
68	Abassi	176	33·2	14·28	—
389	Zagora Z.1	199	28·0	14·14	—
203	Uppers, Government type 4	212	—	—	—
204	,, ,, ,, 15	190	26·0	—	—
Q.1	,, Mill sample	187	—	—	—
Q.2	,, ,, ,, ...	177	—	—	—
R	,, ,, ,, ...	182	—	—	—

Table IV—*continued*

Sample No.	Cotton	Hair Weight per cm. Mgms. × 10^{-5}	Staple Length mm.	Mercerised Diam. μ	Wall Thickness μ
	American				
A.1	Texas Mill sample	204	—	—	—
A.2	,, ,, ,, ...	172	—	—	—
A.3	,, ,, ,, ...	183	—	—	—
B.1	,, ,, ,, ...	209	—	—	—
B.2	,, ,, ,, ...	176	—	—	—
B.3	,, ,, ,, ...	209	—	—	—
C.1	,, ,, ,, ...	196	—	—	—
C.2	,, ,, ,, ...	185	—	—	—
C.3	,, ,, ,, ...	193	—	—	—
C.4	,, ,, ,, ...	186	—	—	—
C.5	,, ,, ,, ...	167	—	—	—
D.1	,, ,, ,, ...	196	—	—	—
D.2	,, ,, ,, ...	196	—	—	—
E.1	,, ,, ,, ...	210	—	—	—
E.2	,, ,, ,, ...	191	—	—	—
F.1	,, ,, ,, ...	176	—	—	—
F.2	,, ,, ,, ...	194	—	—	—
F.3	,, ,, ,, ...	207	—	—	—
F.4	,, ,, ,, ...	209	—	—	—
G.1	,, ,, ,, ...	199	—	—	—
G.2	,, ,, ,, ...	201	—	—	—
94	Texas	208	23·0	14·83	5·03
162	,, ...	208	23·0	—	—
123	,, ...	211	26·0	—	—
85	Upland Mid. grade	235	—	—	—
144	Upland	186	25·0	14·41	—
165	Memphis	215	33·0	—	—
205	Memphis Extras	180	28·5	—	—
—	Salisbury Delta	178	—	—	—
	Indian				
10	Bengal	312	19·4	17·27	7·70
187	Surat 1027 ALF	235	28·5	—	—
197	,, ,, ...	249	26·6	—	—
188	Karunganni	210	19·6	—	—
191	Sircar No. 14	219	27·4	14·89	—
109	Broach	263	24·7	17·42	5·80
159	Bani	215	23·0	—	—
194	Cambodia	193	22·7	—	—
	African				
21	Ibadan-Nigeria	276	29·9	17·39	—
137	Quande	203	27·6	14·69	—
392A	Kenya Taveta 1	150	—	—	—
392B	,, ,, 2	128	—	12·65	—
392C	,, ,, 3	120	—	12·51	—
392D	,, Mivatati 1	166	—	12·73	—
	South American				
47	Peruvian Full Rough	256	30·3	16·06	6·10
168	Smooth Peruvian	165	33·3	—	—
119	Venus—Brazilian	186	36·0	—	—

Table IV—*continued*

Sample No.	Cotton	Hair Weight per cm. Mgms. ×10⁻⁵	Staple Length mm.	Mercerised Diam. μ	Wall Thickness μ
	Miscellaneous				
71	Malta	276	26·8	—	—
394	Trinidad No. 1...	283	30·1	17·01	—
395	,, No. 2...	273	29·0	16·41	—
396	,, No. 3...	162	28·0	13·28	—
474	Kidney—New Guinea... ...	188	30·5	—	—
459	Marie Galante	188	—	—	—
103	Bokhara	187	22·8	—	—
	Exotics				
	Egyptian Seed in America—				
T	Arizona Mill sample	167	—	—	—
U	,, ,, ,, ...	175	—	—	—
V	,, ,, ,, ...	168	—	—	—
	American Seed in India—				
186	Gadag No. 1	188	26·0	—	—
312	,, ,, ...	180	—	—	—
157	,, ,, ...	226	23·7	—	—
163	Indian-American	186	24·5	15·13	—
145	,, ,, ...	186	24·0	14·75	—
96	,, ,, ...	156	30·5	12·78	4·14
120	Punjab-American 285... ...	152	26·2	13·79	—
121	,, ,, 4... ...	201	22·6	15·07	—
195	,, ,, 289... ...	145	30·5	—	—
116	,, ,, AAA ...	155	28·2	13·63	4·39
117	,, ,, BBB ...	151	28·1	13·49	4·48
118	,, ,, CCC ...	151	29·8	13·29	4·36
	American Seed in Africa—				
93	Zaria	172	27·1	14·29	4·30
150	Uganda—Allen A.2	135	33·5	12·51	—
148	Uganda Nyassaland Upland N. 17	165	33·3	14·04	—
147	Uganda Nyassaland Upland N.21	138	30·8	13·34	—
151	Uganda Webber W.	135	30·5	14·01	—
149	,, Sunflower S.7 ...	148	31·8	12·88	—
416	S. Africa Improved Bancroft	171	27·5	—	—
417	,, Barberton Z.1 ...	180	29·8	—	—
	Miscellaneous—				
100	Queensland Durango	165	33·7	14·00	4·40
456	,, ,, ...	148	28·5	—	—
454	,, ,, ...	148	28·8	—	—
450	,, Acala	134	27·3	—	—
136	Queensland	189	29·0	14·85	—
52	Sudan—Sakel	156	—	—	—
360	New Guinea Durango ...	166	26·7	13·73	—
138	Ceylon Durango	154	30·0	12·67	—
139	,, Zululand Hybrid ...	138	31·7	12·83	—
140	,, Watt's Long Staple ...	136	31·0	12·54	—
141	,, Sea Island	116	38·0	11·84	—

Among these results there are several points of interest both to the grower and spinner. For example, in commercial samples of Sea Island cotton the hair weight per cm. would generally appear to lie between 101 and 120, yet the table includes three varieties for which the value exceeds the upper limit. Burd[4], in a variety test on ten Sea Island cottons, found only one with a hair weight per cm. falling outside this range, and that was strain H.23, which gave a value of 128 and which he describes as one of the original Heaton strains established in Montserrat. The Montserrat sample, the value of which is given in Table IV., was also fairly certainly of the Heaton variety; so that it appears as though a hair weight per cm. of 128 to 136 would be quite characteristic of this strain, which might therefore be regarded for practical purposes as a growth peculiar to Montserrat, and as differing considerably from ordinary Sea Island types.

In Egyptian cottons the most striking feature is the uniformity of the results for commercial samples (123-144). The samples of Sakel listed in the table as having values outside this range were in some way or other exceptional. For example, the two samples 383 and 385, with abnormally low hair weights per cm., had both suffered severely in the field from damage by the pink bollworm.

An inspection of the figures for American varieties is convincing of the lack of uniformity in commercial Texas samples. The characteristic range of hair weights per cm. for Texas is roughly 180-210, the lower values being probably accounted for by the presence of immature hairs in excess. This was the case, for example, with the sample C.5.

The Indian class has been made to include Cambodia, which might be regarded more strictly as an exotic. It does, however, differ from the several varieties of American origin grown in India in that its introduction to India was not direct, but after acclimatisation in French Indo-China.

The three East African cottons 392 –B, –C, and –D afford an interesting illustration of the effect of the presence of immature cotton. All three samples were precisely similar in hair width, the low hair weight per cm. of C and D reflecting the proportion of immature cotton present.

Although data are few at present, there are distinct indications amongst the exotic cottons that introduction to a foreign habitat tends to produce a finer hair. The Indian-American varieties, for example, are finer than the original Texas Upland types, although it should be pointed out that in certain cases selection has probably contributed in some measure towards this result. An illustration of this is provided by the Punjab-American cottons 285F, 289F, and 4F, the first two being selections from the last. This fineness is especially characteristic of the Punjab-Americans, but it is shown equally well by Durango grown in Queensland, New Guinea and Ceylon, where selection has played no part in the production of the result.

EMPLOYMENT OF HAIR WEIGHT PER CENTIMETRE IN THE IDENTIFICATION OF COTTONS

When employed alone the value of hair weight per cm. is strictly limited as a character for the identification of a cotton owing to the wide range of weight covered by different samples of the same cotton, and the consequent overlapping of range from class to class. In conjunction with other measurable characters, however, it has been repeatedly found to be a useful guide, not only to the identity of particular cottons, but also to the causes

of sundry special cases of difficulty encountered from time to time in the spinning and manufacture of cotton.

The typical cases described below, in which determinations of hair weight per cm. have been involved, consisted not only of samples of raw cotton but also of yarns and fabrics in the grey as well as in variously finished states. It has been necessary therefore as occasion has arisen to determine experimentally the effect of different finishing processes upon the measurable characters of the cottons involved, and the steps to be taken to determine an approximately correct value of these.

As the result, the procedure briefly described below has been followed when it has been required to determine the hair weight per cm. of the cotton in sized or finished goods.

(1) *Grey Yarn or Cloth* (*Unsized*).—The yarn is carefully untwisted and pulled down, and the hairs obtained are collected into a sample and treated in the same way as a raw cotton sample. (See Appendix.)

(2) *Grey Yarn or Cloth* (*Sized*).—The size is removed by treatment with a 0·5% solution of diastofor for 20 hours at 40° C., iodine solution being used to indicate the completeness of the size removal. Any non-starchy materials present in the size were at the same time loosened to an extent which facilitated its removal by careful washing and agitation. After drying, the usual procedure for unsized yarn was followed.

(3) *Bleached Yarn or Fabric.*—A correction is necessary in the case of hair weight per cm. for the loss of weight in the bleaching process. This correction cannot be accurately determined, since it will largely depend on the effectiveness of the scour; but no serious error is involved if the loss in weight is taken as 6%.

(4) *Mercerised Yarn or Fabric.*—When mercerised under tension, yarn suffers no appreciable change in count, so that no change was expected in hair weight per cm. To test this point, a lea of unbleached Sea Island yarn (180's) was tested for both counts and hair weight per cm. before and after mercerisation, with the following result—

Grey	Counts		Hair Weight per Centimetre
Before mercerisation... ...	183	...	110
After mercerisation	188	...	108

Thus the value of hair weight per cm. obtained from a sample of mercerised material can be regarded as equivalent to that of the original raw cotton, subject, naturally, to a correction for bleaching when this has taken place.

The following are typical special cases—

Case 1

It was desired to ascertain the kind of cotton from which a very attractive soft spun yarn had been made. The yarn was white and very bright, full but harsh, and about 26's counts. The hair weight per cm. was 236, indicating that the cotton was probably either Indian, Memphis, or Rough Peruvian (see Table IV.). The staple was found to be full 1¼ in., thus ruling out Indian; while the Memphis was excluded on account of the harsh feel. Furthermore, Memphis is rarely found to be as long as this. It was concluded, therefore, that the cotton employed was Rough Peruvian.

Case 2

It was required to identify the cottons used in three fabrics manufactured and finished in India. The finish was so superior that it appeared very unlikely that a low grade raw cotton had been employed.

The staple length of the cotton in warp and weft of all three samples was about 15/16ths inch, while the six values of hair weight per cm. fell between 264 and 270. The evidence was therefore conclusive that in all samples the cotton was Indian, most probably of the Broach type (see Table IV.).

Case 3

Two cloths, A and B, of similar manufacture and quality, were submitted. A was a foreign competitive cloth which was underselling B. It was required to know whether inferior cotton was being used in A. In both the two warps and wefts the staple length was identical, so the hair weight per cm. was determined for all four yarns as follows—

	Warp		Weft
Cloth A	216	...	212
Cloth B	208	...	208

Thus there was no significant difference of hair weight per cm. throughout, and the variety and quality of cotton in both fabrics was probably the same.

Case 4

Here it was desired to know whether the cotton in a mercerised and dyed poplin was Sakel or Sea Island. The hair weight per cm. was found to be 136 in the warp and 138 in the weft, while in both cases the staple length was $1\frac{7}{16}$ in. Reference to Table IV. will show that, in exceptional cases, it is possible to obtain a Sea Island cotton with the above hair weight per cm., but the staple length ruled out this possibility and increased the probability that the cotton was Sakel.

Case 5

In this case a distinct bar, about one cop in width, of much darker shade, ran across the full width of a piece of grey cloth. Tests of the weft, both of the bar and of the lighter normal portion, gave the following results—

	Hair Weight per centimetre	...	Hair Width (μ)
Light portion	200	...	19·00
Darker bar ...	177	...	17·30

The cotton of the weft in the bar was therefore of a different character from that of the weft of the main body, the probability being that a cop of different yarn had accidentally found its way into the delivery of yarn at some stage previous to manufacture, or that it was a simple case of the mixing of weft in the weaving shed.

Case 6

Two batches of a grey poplin, A and B, presumed to be identical, had been finished in exactly the same manner during mercerisation and dyeing. The batch B, however, was found to have finished with an inferior lustre and to have dyed to an appreciably different shade. This difference might have been regarded as due to a difference either of cotton, mercerisation, or dyeing.

Determination of the measurable characters showed that both warps contained the same cotton, but the wefts were different, the hair weights per cm. being 182 and 199 for A and B respectively. The weft in B was therefore perceptibly the coarser, and, under mercerisation without tension,

turned out to be less capable of swelling in the caustic soda than A. It was consequently of inferior mercerising quality.

Only speculation is possible as to the cause of such a difference, the most reasonable assumption being that a slight change had taken place in the marks of cotton used for the weft yarn. It is improbable that such a change would have been noticeable either in the raw cotton or during spinning.

These cases are sufficient to establish the fact that, so far as the differentiation and identification of cottons are concerned, the character of hair weight per cm. can be put to considerable practical use. At the same time there are distinct limitations to its applicability for the latter purpose, especially in the case of yarns spun from a mixture of two varieties. For example, it is possible to obtain a Tanguis and a Memphis cotton of the same staple length and also the same hair weight per cm.; so that a mixture of these two would be indistinguishable from either of the pure cottons. Again, a cotton with a hair weight per cm. of approximately 235 might either be a pure Indian or a mixture of a coarser Indian with an American cotton. The limitations imposed in this manner are well shown by the following example—

Case 7

Here it was desired to test whether a reputed super-carded Egyptian warp yarn was in accordance with its description. The staple length was found to be $1\frac{3}{8}$ in., but the hair weight per cm. was 148. This value is at the greatest extreme for Sakel (Table IV.), and comparatively seldom encountered. It is possible therefore that the yarn had been spun from a finer cotton adulterated with a small admixture of some other fairly long stapled but coarser cotton, such as Pilion or Assili. In other words, the methods employed are not yet fine enough to distinguish small adulterations. The limit of knowledge of the measurable characters of cotton has, however, by no means been reached, and the possibility of giving more definite information on points of this kind will no doubt increase as this knowledge is extended.

THE RELATION OF HAIR WEIGHT PER CENTIMETRE TO OTHER MEASURABLE CHARACTERS

In the discussion of the technique of measurement (Appendix) it is shown that in any one sample no significant relation exists between hair weight per cm. and hair length; nor is there any obvious biological reason for the contrary expectation. From elementary geometrical considerations a fairly close correlation is, however, to be expected between hair weight per cm. and both the width of the hair and the thickness of its cell wall.

In Fig. 1 the staple lengths of 59 cottons have been plotted against hair weight per cm. It is clear that although, broadly speaking, there may be, over the whole range of cottons, a general relation between these two quantities, it would be unjustifiable to apply this within narrower limits. In other words, the oft-repeated generalisation that the longer cottons are also the finer is true only in the above limited sense.

For ease of reference, some of the points in Fig. 1 are labelled. The cottons from which these points were obtained illustrate the lack of applicability of the above generalisation in practice. This is also shown by the data given in Table V.

Table V.

Cotton		Staple Length (Inches)		Hair Weight per Cm.
Karunganni ...	...	$\frac{3}{4}$	...	210
Trinidad Native 2	...	$1\frac{1}{8}$	...	273
Trinidad Native 3	...	$1\frac{1}{8}$	...	162
Brazilian-Venus	...	$1\frac{7}{16}$	...	186
Karunganni ...	...	$\frac{3}{4}$	...	210
Memphis ...	...	$1\frac{5}{16}$	...	215

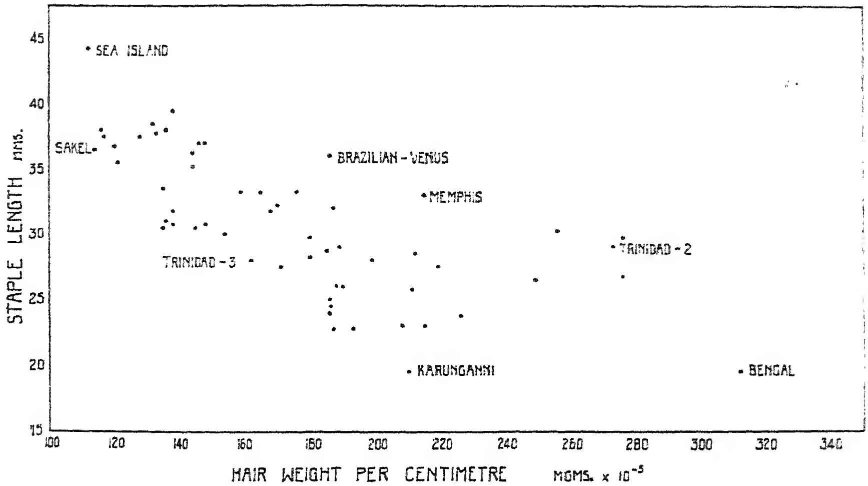

FIG. 1

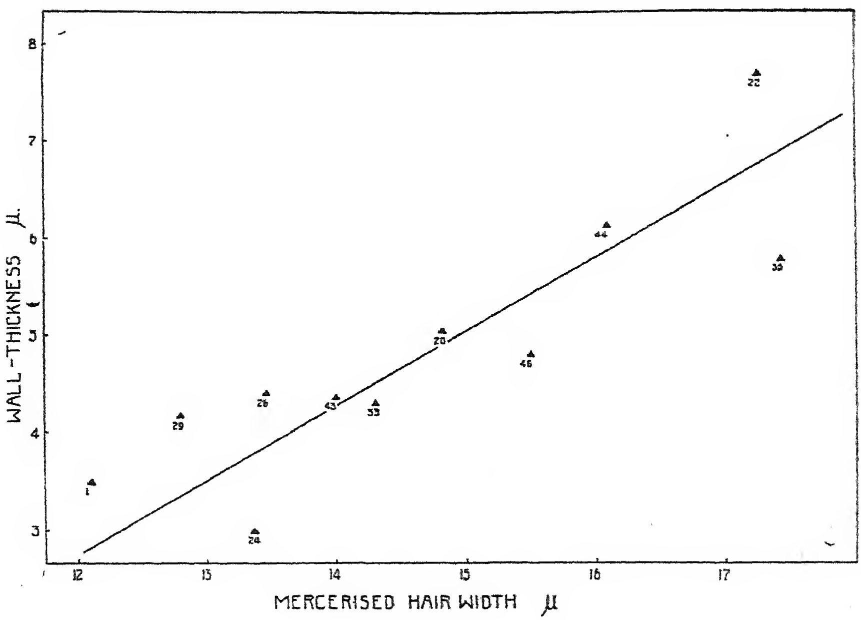

FIG. 2

For key to numerals see Fig. 3.

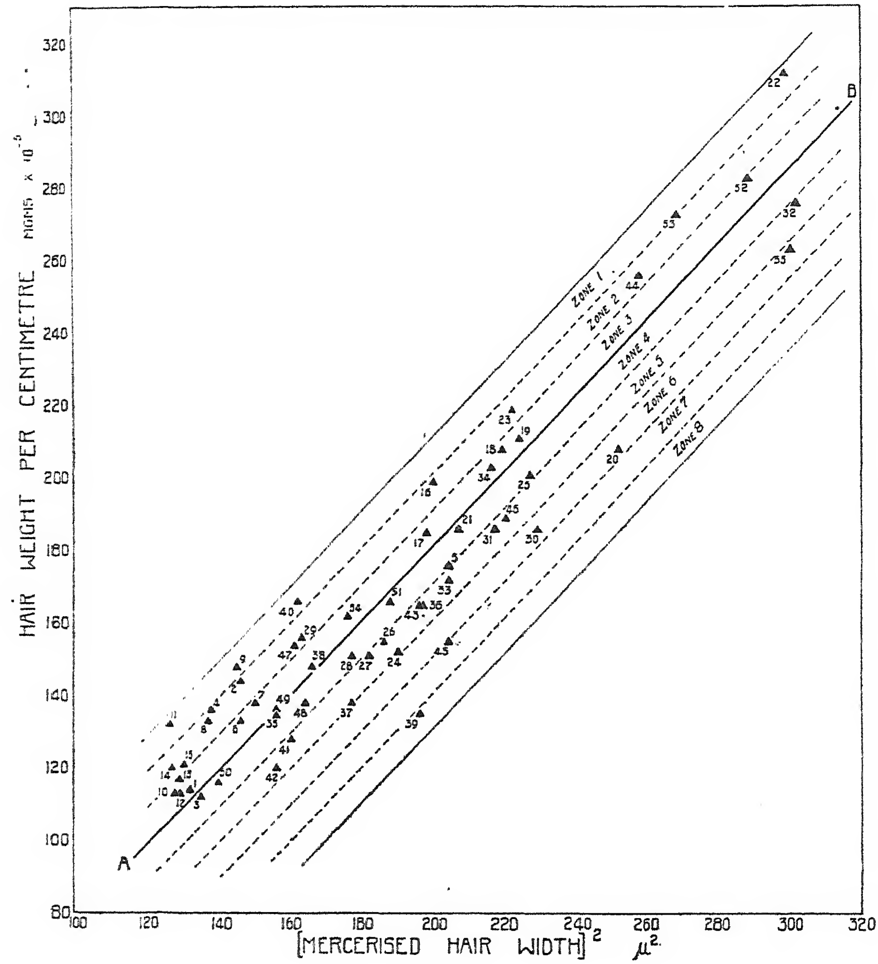

FIG. 3

1—Sea Island
2—Assili A/22, 1923.
3—Sea Island.
4—Sakel X, 1923.
5—Abassi.
6—"310 X," 1923.
7—Uppers.
8—Sakel C/22.
9—Sakel S.1.
10— ,, S.2.
11— ,, S.3.
12— ,, S.4.
13— ,, S.5.
14— ,, S.6.
15— ,, S.5a.
16—Zagora Z.1.
17— ,, Z.2.
18—Texas.
19— ,,

20—Texas.
21—Upland.
22—Bengal.
23—Sircar 14.
24—Punjab American 285F.
25— ,, ,, 4F.
26— ,, ,, AAA.
27— ,, ,, BBB.
28— ,, ,, CCC.
29—Indian American.
30— ,, ,,
31— ,, ,,
32—Ibadan-Nigeria.
33—Zaria.
34—Quande.
35—Uganda A.2.
36— ,, N.17.
37— ,, N.21.
38— ,, S.7.

39—Uganda Webber.
40—Kenya Mivatati 1.
41— ,, Taveta 2.
42— ,, Taveta 3.
43—Queensland Annual Durango.
44—Peruvian Full Rough.
45—Queensland Ratooned Durango.
46—Queensland.
47—Ceylon Durango.
48— ,, Zululand Hybrid.
49— ,, Watts Long Staple.
50— ,, Sea Island.
51—New Guinea Durango.
52—Trinidad 1.
53— ,, 2.
54— ,, 3.
55—Broach.

In order to evolve a working hypothesis as to the inter-relation between hair weight per cm. and the other properties of the cell, it is necessary first of all to determine whether or not there is any relation between the width of the original cell and the amount of cellulose laid down as secondary thickening. Calvert and Summers[6] have shown that the former bears a definite relation to the mercerised width, so this quantity has been correlated with the wall thickness* in the case of 12 cottons (Fig. 2). The number of points is admittedly small, but the correlation coefficient is

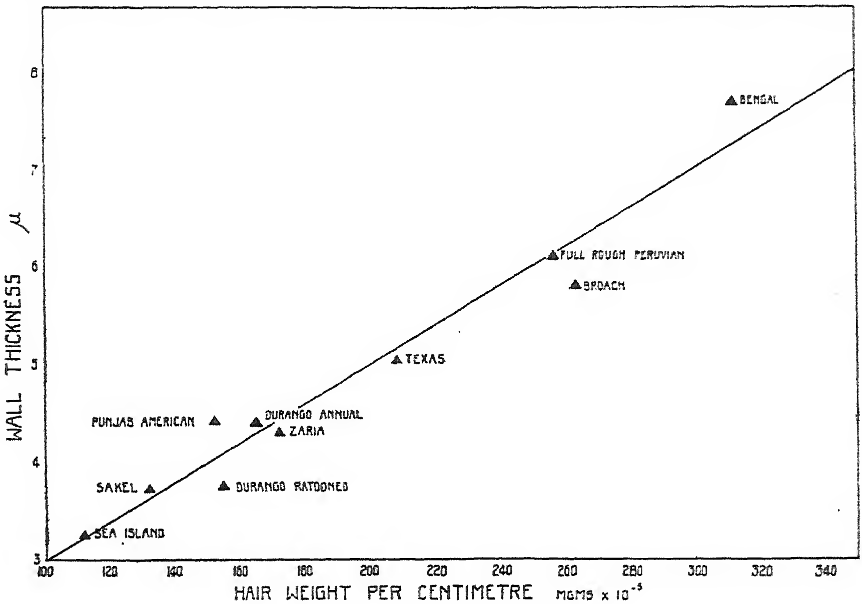

FIG. 4

+0·86, so that there is no doubt but that an increase of one of the dimensions is generally accompanied by an increase in the other.

In plotting the points it has been assumed that the relation should be expressed by a linear equation, since there is no evidence to justify any other assumption. It is interesting to note that the rate of increase of wall thickness is greater than that of mercerised width, thus indicating that hairs with the greater widths tend to be the more fully developed.

The relation between hair weight per cm. and mercerised width is shown in Fig. 3. Here the square of the mercerised width is taken because not only do the points then fall more closely in a straight line, but also because it can be shown that weight per cm. should involve the second power of mercerised width, probably in quadratic form. The values of 55 cottons were taken, and the correlation coefficient found to be +0·95.

It is clear that, assuming constant cellulose density, any variation from perfect correlation must be due to independent variation in wall thickness. Thus all points falling above the line AB which most fairly indicates the general relation between the two characters, would be expected to represent

* The wall thickness values quoted in Table IV. and used in this paper were obtained from hair sections, and are therefore greater than the real values owing to the swelling in gelatin.[6]

well-developed cottons, whilst those falling below should signify immaturity. To illustrate this the chart was divided up into arbitrary zones, and sections cut of four cottons from zones 1 and 2, and four from zones 6, 7 and 8.

These sections are shown in Plates I. and II., where it will be seen that the above deduction is justified.

It can also be shown that in a similar way hair weight per cm. should involve the square of the wall thickness. There were, however, only ten pairs of values available for showing the relation, so for correlation purposes there is no useful purpose served by plotting them in any other way than linearly, as shown in Fig. 4. Here the correlation coefficient is $+0{\cdot}98$, and although the number of observations is small, it is nevertheless clear that the relationship is relatively rigid.

This is of particular interest with reference to the work done by Clibbens and Ridge[9], who used the weight per cm. as an indication of wall thickness, and it will be appreciated that since the former varies as the square of the wall thickness, it can be considered quite a delicate test.

APPENDIX

The Technique of Hair Weight per Centimetre Determination

The first process is the preparation of a sample, for cutting into centimetre lengths, which represents in the correct proportion the whole range of hair weight per centimetre occurring in the bulk. This is done by taking at random a large number of wisps of hairs from the bulk; and, having divided them into four for convenience of working, each portion is thoroughly mixed by repeated drawing and doubling between the thumb and forefinger of each hand. In this way the hairs are more or less parallelised; but there still remain a considerable number of tufts and entanglements, so these are removed by careful combing with a fine steel comb. The parallelisation process is thus completed.

The four portions are still too large for cutting, so a small "staple" of four or five hundred hairs is pulled from the fringe of each. This process necessarily means the selection of the longer hairs, but it has been shown that for practical purposes the results are quite unaffected thereby, since the hair weight per centimetre of long hairs in a sample is the same as of short ones. This was demonstrated in the following way.

A sample of F.G.F. Sakel of $1\frac{3}{8}$ in. staple was split up by means of a Baer sorter into three groups as below, and the hair weight per cm. of each separately determined. The results showed that the value for the latter quantity is independent of length.

	Length	Hair Weight per Cm.
Group 1	2·5 to 3·5 cm. ...	151
Group 2	2·0 to 2·5 cm. ...	151
Group 3	Under 2·0 cm. ...	149

Each "staple" is then clipped to the edge of a piece of linoleum by means of an ordinary paper clip, and, having been smoothed out straight, is held in position by the tip of one finger. Centimetre lengths are then cut from the middle by means of a special cutter consisting of two razor blades set one centimetre apart in a brass holder. The setting is checked before each determination by cutting marks on a specially prepared waxed glass slide, and measuring the distance between the cuts so made by means of the vernier on the mechanical stage of a microscope. Care must be taken that

the blades are sharp, so that the cutting is done cleanly and with no sign of pulling of the hairs, since this causes inaccuracies in spite of careful blade setting.

To determine the effectiveness of this method of cutting, thirty lengths were taken at random from a prepared sample and accurately measured. The mean length was found to be 9·97 mm. $\pm$0·008, the error in this case being 0·3%, which for practical purposes can be ignored.

The four bundles of centimetre lengths thus prepared are placed between two microscope slides so that a fringe of about 2 mm. protrudes. Lots of 200 lengths are then counted out into a black glass dish, taking 50 at random from each of the four cuttings. It has been found that the operation of counting is made much easier if both surfaces of the slides used for holding the sample are covered with black matt paper.

Having rolled each bundle of 200 hairs into a composite mass by means of a small piece of clean dry cork, they are weighed separately on the micro-balance. This consists of a glass beam mounted on an horizontal quartz fibre, which is carried by a brass frame possessing an adjustment for altering the tension (Fig. 5). To obtain reasonable deflections without the use of an extra fine fibre, the beam is made as long as possible consistent with the strength of the fibre, and rigidity is combined with a minimum of weight by using for its construction drawn-out glass tube.

When a load is applied, the deflection is measured by an optical arrangement and compared with that produced by a standard weight.

All determinations mentioned in this paper were carried out under natural atmospheric conditions, since it was desired to evolve a method for everyday use, and its scope of application would be seriously limited by the necessity of humidity control. Tests on the moisture content of the air, however, were carried out over a period of several months in order to make correction if necessary. It was found from moisture regain tables that under the conditions of testing, the maximum error introduced in the weighings was only of the order of 1·0%, and could therefore be ignored for the general purposes of this work. When it is desired to detect small differences in weight, or where a comparative test is to be made between two closely allied cottons, the effect of atmospheric moisture can be discounted by carrying out the weighings simultaneously, or by correcting for differences in moisture content by the use of such tables as are given by Urquhart and Williams.[15]

Clegg and Harland[7] found that a probable error of the mean of 3% could be obtained with 80-160 hairs, depending on the variability of the sample. This accuracy, however, was not considered sufficient for the purposes of the present work, and in order to reduce the probable error to the neighbourhood of 1%, it was calaculated that 1,000 hairs would have to be taken; i.e., five weighings of 200 hairs each. The result of any one test is therefore incapable of statistical treatment so far as significance is concerned, since the number of actual observations is not sufficiently large. This is shown by the following example of a duplicate test on Quande cotton, in which the significance of the second determination is indicated to be more than twice that of the first—

(*a*) Hair weight per cm. = 202. M.D. = 0·21%.

(*b*) Hair weight per cm. = 204. M.D. = 0·09%.

It is clearly impossible therefore to state accurately what the significance of a result may be, but experience has verified the conclusions arrived at

by Clegg and Harland, so that after allowing for all possible sources of error, it is safe to regard any difference greater than 4% as real.

A list of duplicate determinations is given in Table VI., which shows that results can be repeated with a very close degree of correspondence.

Table VI.

Variety of Cotton	Hair Weight per Cm. (a)	(b)
Quande	202	204
Ceylon—Zululand hybrid	138	142
White Egyptian	168	165*
Cotton 310 X	128	127*
Assili Nahda 24	159	159*
Sakel C/24	134	135*
Uppers Egyptian	173	173
Sakel	131	134
Texas	195	197
Arizona	168	165

*From Yarn.

The soundness of the method has also been demonstrated by several independent observers, who, by following the instructions given above, have set up their own balances and have never differed significantly in the evaluation of the same samples.

The author is indebted to Miss G. G. Clegg for the measurements of wall thickness; to Miss M. Calvert for the hair width data; to Mr. C. W. Bradley for help in the routine determinations of hair weights; and to Mr. H. Gunnery for preparing and photographing the sections.

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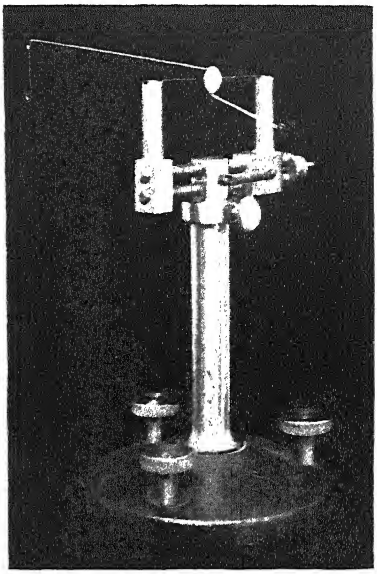
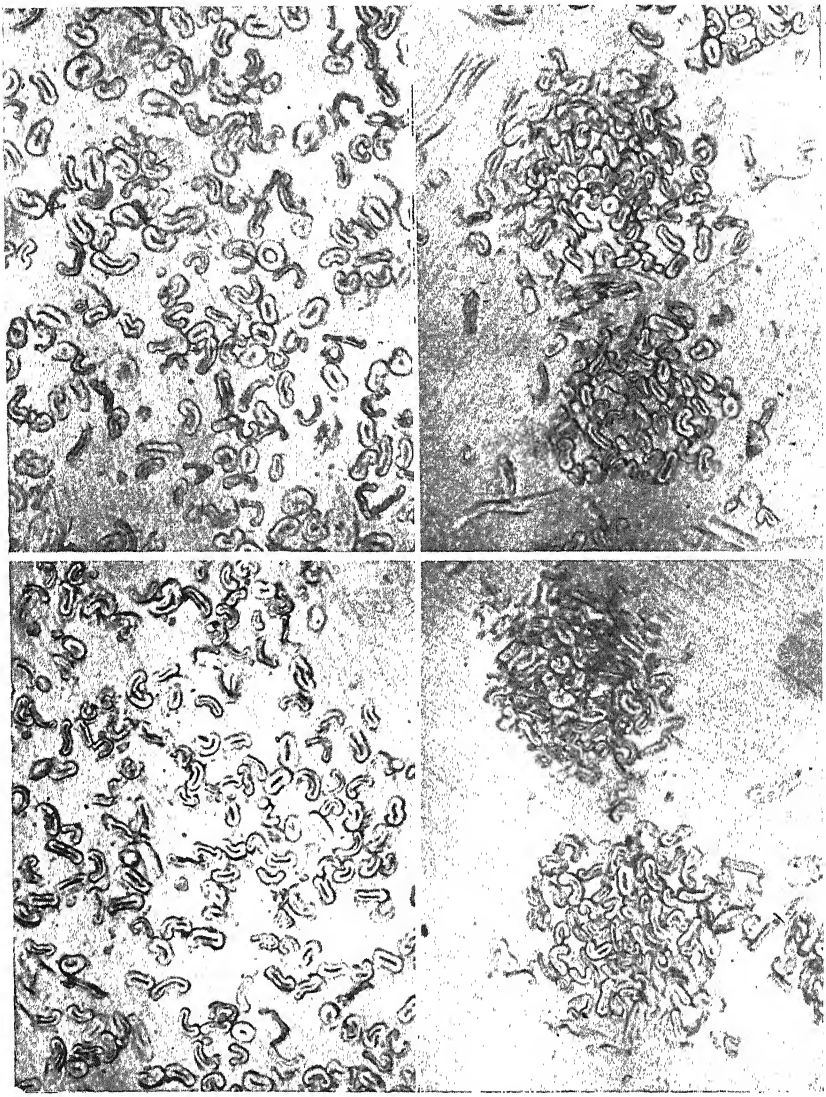


FIG. 5

20 Texas | 37 Uganda N21



45 Queensland Ratooned | 39 Uganda W.

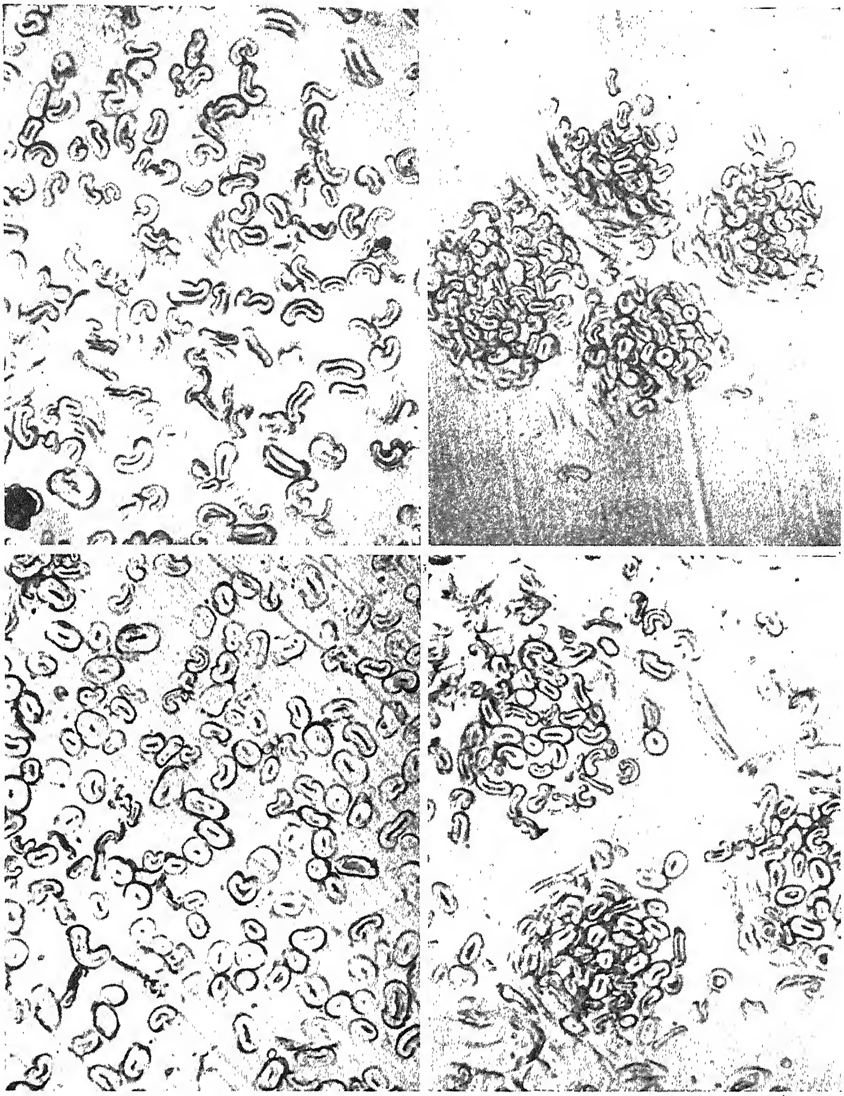
PLATE I.

Cross-sections of rather immature cotton hairs.

No.	20	falls within	zone	6	of Fig. 3
,,	37	,,	,,	5-6	,,
,,	45	,,	,,	6-7	,,
,,	39	,,	,,	8	,,

53
Trinidad 2

9
Sakel S.1



22
Bengal

16
Zagora Z. 1

PLATE II.

Cross-sections of well-developed cotton hairs

No.	53	falls	within	zone	1-2	of Fig. 3
,,	9	,,	,,		1	,,
,,	22	,,	,,		1	,,
,,	16	,,	,,		2	,,

50—AN EXPERIMENTAL METHOD FOR INVESTIGATING THE THERMAL PROPERTIES OF COTTON FABRICS

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(The British Cotton Industry Research Association)

Summary

The essential requirements of fabrics for maintaining the body at normal temperature under tropical conditions are shown to be high reflecting and emissive powers, low transmitting power for radiant energy, and high permeability to moisture.

Some experimental methods are described by which the thermal properties of fabrics may be studied. Using one typical fabric made for export to the Tropics, it is shown that the total heat reflected is approximately equal to the total heat transmitted, thus indicating the relative importance of these two modes of heat transference. A method is described by means of which the amounts of heat transmitted by fabrics may be compared, and the results of tests on a range of materials typical of those exported to the tropics are given to indicate the scope of the method.

Testing the fabrics in the dry state, it was found that the most transparent allowed about five times as much heat to pass as the least transparent, this being due to differences in construction, involving such matters as filling, weave and so forth. There was a certain degree of irregularity from place to place along the length of a fabric in the heat transmitted, but this irregularity was independent of the amount of heat transmitted.

The effect of washing the fabric has been determined in relation to the loss of weight and the amount of heat transmitted. The greatest increase in heat transmitted occurred when most filling was removed, and heavily filled fabrics lost their heat insulating value almost entirely on washing. Some fabrics which had not been filled transmitted less heat after washing, owing to shrinkage.

The most suitable of the fabrics tested for tropical use appeared to be one which was heavy and affected little by washing.

A method for comparing the total heat reflecting powers of fabrics has yet to be devised.

The effect of the moisture content of a fabric on its transmitting and reflecting powers has been studied. The heat transmitted decreased, with the four fabrics examined, in direct proportion to the increase in relative humidity of the atmosphere with which the fabric was in equilibrium. The mean decrease on changing from dryness to saturation was 22·7 per cent., but the decrease was greatest with those fabrics which transmitted least heat when dry. The effect of moisture content on the heat reflecting power was only examined in one case, but appeared to be insignificant.

INTRODUCTION

The object of this investigation is to consider the influence of the structure of various types of fabrics on the transference of heat. It is intended to examine the thermal properties of cotton fabrics used as clothing with special reference to their possibilities in maintaining the body at normal temperature under tropical conditions. The choice of fabrics for clothing in tropical countries appears to be determined more by considerations of price or custom than by their heat protecting qualities, but whilst the subject of what constitutes suitable clothing is extremely complex, certain essential properties may be stipulated if the material is to provide an adequate outlet for the heat of the body.

Before proceeding to a more detailed consideration of the problem it is necessary to indicate the meaning of the terms employed and the manner in which heat transference may take place.

In the science of heat, those phenomena are investigated which are revealed by the sense of warmth or cold. The words hot or cold are used to describe the conditions of external bodies which correspond to the sensations received through the skin on touching or approaching them, and bodies are compared with respect to the sensations so received, one being described as hotter or colder than another. The number which expresses on some definite scale how hot a body is, is termed its temperature.

Heat itself is a form of energy which, increasing in a body, causes a rise in temperature, and, escaping, causes a fall.

It is a matter of common observation that bodies in contact with each other, and not subject to changes of external condition, after a time get neither hotter or colder, that is, heat does not pass from one to another, and they are then said to be in "thermal equilibrium."

Transference of Heat

There are two modes by which heat is transferred from one portion of matter to another—conduction and radiation. In conduction the matter receiving the heat is in contact with the matter from which it receives it, and the temperature falls continuously along the course by which the heat is flowing.

In radiation the matter receiving the heat is not in contact with the matter from which it receives it. In fact, any matter through which the radiation passes may be hotter or colder than either or both the bodies between which it is passing. It must not be supposed, therefore, that the energy passes from one to the other as heat, but that, on leaving the sender, it is converted from heat energy into another form, which is termed radiant energy, to be reconverted into heat on reaching the receiver. The warmth received from the sun or a glowing fire is a familiar example of this heating effect.

The emission of radiation is not confined to bodies at high temperatures, but takes place continuously from all bodies at all temperatures. A body losing more heat by emission than it receives by absorption of radiant energy is said to lose heat by radiation, the magnitude of the effect being denoted by the term "emissive power."

The problem of maintaining the body at normal temperature under conditions of tropical heat is one of thermal equilibrium. In addition to the heat generated by the natural functions of the body, a considerable amount of heat is received from the sun either directly or through the medium of the clothes. If the temperature of the body is to remain normal an amount of heat must be dissipated equal to that due to the above causes. The amount of heat received by the body from the sun must be as small as possible, and consequently a fabric possessing a high reflecting power for radiant energy is required. Since the clothes are exposed to heat loss by the emission of radiation and contact with cooler air, as well as loss of heat by evaporation of the moisture in the clothes, as much as possible of the heat from the sun remaining after reflection should be absorbed by the clothes. Any heat received by the body must be dissipated through the medium of the clothes. If the condition of the air as regards relative humidity, rate of movement or temperature, is insufficient to cause the required heat loss, cooling can

only be obtained by the evaporation of the moisture generated by perspiration. This evaporation must not be obstructed, and takes place through the medium of the clothes, or may be brought about by suitable arrangement of a loose garment which provides a bellows action through the movement of the body. If the body is at a higher temperature than the outer surface of the clothes, a certain amount of heat will be lost by conduction, and it will be advantageous if the clothing is a good conductor of heat. This advantage is offset by an increased tendency to chill, ruling out high conductivity therefore as being a doubtfully advantageous quality.

The requirements of a fabric in order that it may provide efficient clothing under tropical conditions of heat can therefore be summarised as follows—High reflecting and emissive powers, low transmitting power for radiant energy, and in addition high permeability to moisture.

In addition to direct transmission of heat through the interstices of a cotton fabric, a considerable amount of heat is transmitted owing to internal and external multiple reflections from the walls of the individual cotton fibres. The manner of heat transmission and reflection by a fabric is therefore most complex. If a determination of the transmitting or reflecting power is to prove of practical application, it is necessary that the conditions of test should bear a direct relationship to the conditions under which the fabric is to be employed. The nature of the radiant heat used in testing must be specified, and also the state of the fabric regarding moisture content.

The measurement of the total amounts of heat reflected and transmitted presents many difficulties. It is possible to measure the intensity of heat at a large number of points around a small area of fabric on which radiant energy is incident, and from these observations to calculate the total energy transmitted and reflected, but in the measurement of the transmission of heat it will be shown that it is necessary to test a considerable area of fabric owing to the variation of heat transmitted from point to point on the fabric. Consequently the above method, in addition to manipulative and experimental difficulties, would prove impracticable owing to the time occupied by testing a single type of fabric. The method described below for the determination of the heat transmitted by a fabric enables a factor to be determined by means of which the amount of heat transmitted by different fabrics may be compared.

Concerning reflection of heat by fabrics, the variation in intensity of reflected heat in a given direction from point to point on the surface of a fabric is found to be small, but apart from the laborious method indicated above a scheme for comparing the powers of total reflection of heat by fabrics has not yet been evolved.

EXPERIMENTAL METHODS AND RESULTS

Owing to the necessity for the maintenance of the fabric under controlled conditions of temperature and humidity, and in addition the prevention of both draughts and stray radiation from disturbing the thermopile (the instrument used for measuring the heat), both the fabric and thermopile are placed in an airtight glass vessel. The temperature of the vessel is controlled by immersion in a water bath maintained at a constant temperature of 25° C. The inside of the glass vessel is protected from stray radiation by means of blackened metallic screens, the stream of radiant energy being admitted by a window in the top.

The source of heat employed is one that fulfils approximately the conditions for the emission of total radiation. The furnace is heated by a steady current from a 40-volt accumulator, and consists of a silica tube fitted with suitable diaphragms and wound with resistance wire. The outside of the tube is lagged with magnesium oxide, and the containing cylinder is water-cooled, whilst the lower end of the tube is fitted with a water-cooled, blackened copper diaphragm maintained at constant temperature. The diaphragm serves as a screen for the hot furnace, and limits the beam of radiation to the required extent. A water-cooled blackened copper shutter is used to intercept the stream of radiation as required, the temperature being maintained constant by first passing the water through a copper coil immersed in the large water bath. After passing through the shutter the water is circulated through the copper diaphragm and containing cylinder of the furnace.

The instrument employed for the detection and measurement of the radiant heat is a Moll thermopile, a central cross section of which is indicated in Figs. 1 and 4. The receiving surface of the thermopile is protected by a fluorite window, which is transparent to radiation. The brass body of the thermopile may be fitted with either of two caps, one possessing a cylindrical opening and the other a slit of variable width. A galvanometer of the D'Arsonval type is used in conjunction with the thermopile, the deflection consequent on the falling of radiant energy on the receiving surface of the thermopile being indicated by the movement of a spot of light on a millimetre scale.

Relation between Amounts of Heat Reflected and Transmitted by a Fabric

In order that the relation between the amounts of heat reflected and transmitted might be determined approximately, and to indicate the manner in which the heat intensity is distributed, a test was made on a specimen of fabric (No. 2) permanently fixed on a wire frame two and a half inches in diameter. The radiant energy was incident in a direction normal to the fabric, while the thermopile was capable of rotation about an axis contained in the plane of the fabric. The cap of the thermopile was furnished with an extension of brass (Fig. 1), blackened on the inside, and of such dimensions that the sensitive surface of the thermopile received heat from a limited area of fabric. The deflections of the galvanometer were noted corresponding to positions of the thermopile when rotated through successive angles of nine degrees. With angles of reflection less than eighteen degrees, the body of the thermopile obstructs the radiant energy incident on the fabric, and in this range observations are not possible.

By plotting intensities of reflected heat as ordinates and angles of reflection as abscissæ, a curve is obtained which indicates the distribution of heat intensity from a constant area of fabric at a fixed distance from the fabric in a given plane of incidence (Fig. 2). An estimate of the amounts of energy reflected and transmitted may be arrived at on the assumption that the intensity curve is the same for all planes of incidence. In Fig. 3 the amounts of energy corresponding to definite small ranges of angles of reflection are plotted as ordinates against the angles of reflection as abscissæ. Consequently the area under the curve represents the total energy dissipated by the fabric.

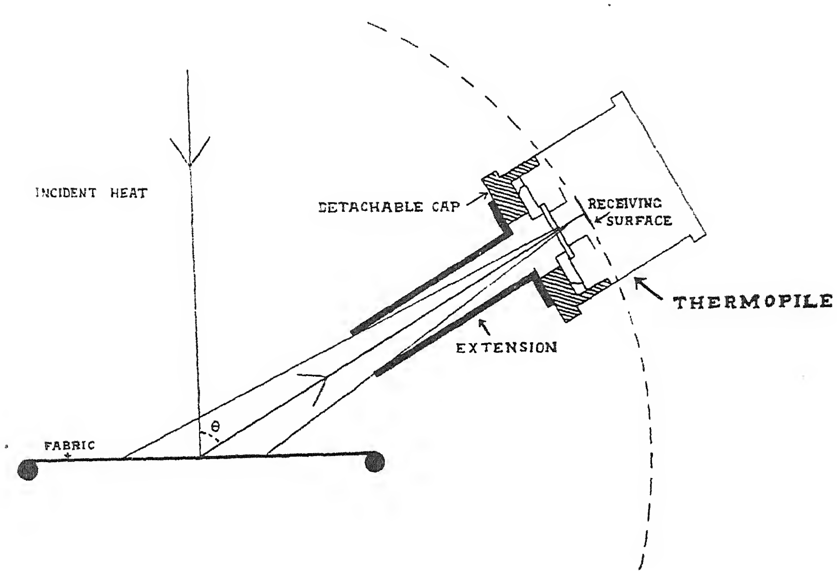
INCIDENT HEAT
DETACHABLE CAP
RECEIVING SURFACE
THERMOPILE
EXTENSION
θ
FABRIC

FIG. 1

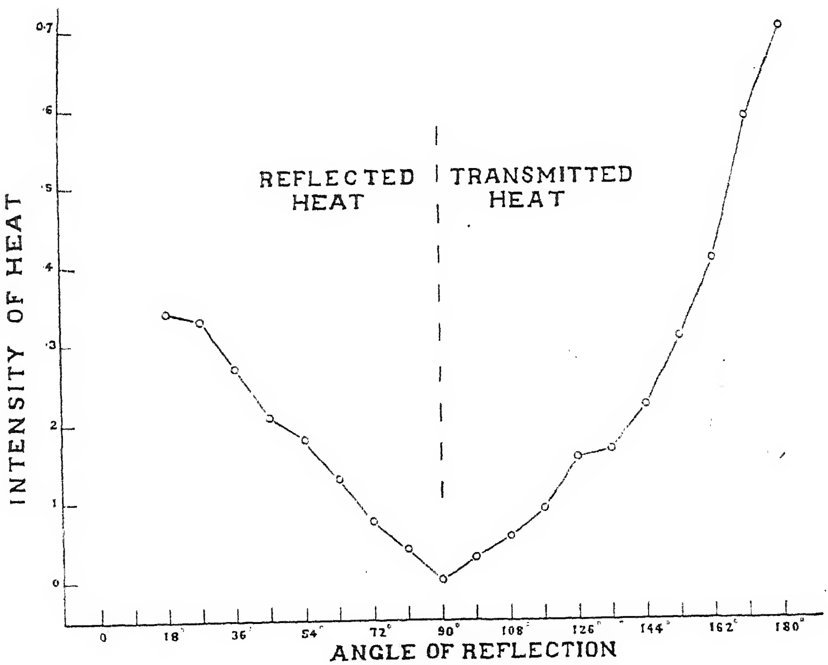
0·7
·6
·5
·4
·3
2
1
0
REFLECTED HEAT
TRANSMITTED HEAT
INTENSITY OF HEAT
0
18°
36°
54°
72°
90°
108°
126°
144°
162°
180°
ANGLE OF REFLECTION

FIG. 2

Since the total area represented by the range 0°-90° is approximately equal to that represented by the range 90°-180°, the total heat reflected is approximately equal to that transmitted.

Although the accuracy of this determination is not high, owing to the small amounts of heat received by the thermopile, it serves in a general way to indicate the relative magnitude of the amounts of heat reflected and transmitted. In this determination the humidity of the atmosphere surrounding the fabric was that of the room.

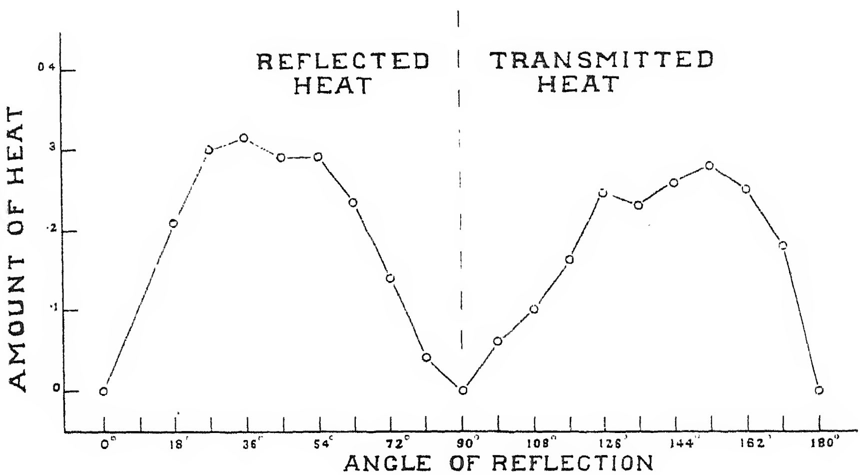

FIG. 3

Transmission of Heat

The method adopted for the comparison of transmitting powers for radiant heat of various types of fabrics is as follows. The fabric to be tested is placed with its surface towards the source of heat, so that the radiant energy is incident normally (Fig. 4). On the opposite side of the fabric is placed the thermopile, a short distance away. The relation between the amounts of heat received by the surface of the thermopile at various distances from the fabric over the range $\frac{3}{4}$ to $2\frac{1}{2}$ inches, has been shown to be linear. Any given portion of the thermopile receiving surface receives heat from an area of 8 sq. cms. of fabric when in the position shown in Fig. 4. No ray which makes an angle greater than 35 degrees with the normal to the fabric reaches the thermopile receiving surface, this angle being independent of the distance of the thermopile from the fabric.

It is found necessary to maintain the fabrics under a constant tension which is insufficient to cause appreciable stretching. A strip of the fabric, $2\frac{1}{2}$ inches wide and 36 inches long, is wound on two rollers RR, and in addition passes over a fixed bar S and a rubber-covered roller T, the number of revolutions of which indicates the distance of the portion under test from a fixed point on the fabric. The axles of the rollers RR are subject in turning to a frictional force applied by small slabs of cork pressed against the axles by means of a strip of springy steel. Different portions of a fabric may be examined by winding from one roller on to the other. Several strips of fabric may be joined when it is desired to test a number of fabrics under the same conditions. Between successive strips are placed short strips of paper in the centres of which holes are cut two inches in diameter so that

the radiant energy received by the thermopile direct from the source may be measured without removing the fabric from the rollers. Since the thermopile is in close proximity to the fabric, any change in temperature of the fabric due to absorption of radiant energy or other cause, is evidenced in the slow movement of the galvanometer coil. In order to eliminate this effect the following procedure is adopted. With the shutter closed, the reading of the spot of light on the galvanometer scale is noted, and immediately afterwards the shutter is opened. After a fixed time interval of one minute, in which the galvanometer has reached its maximum deflection, the reading is observed and the shutter closed. After a further interval of one minute the final reading is observed. The mean of the initial and final readings is the zero from which the deflection is determined. The creep of the zero reading is small compared with the deflection measured but cannot be neglected.

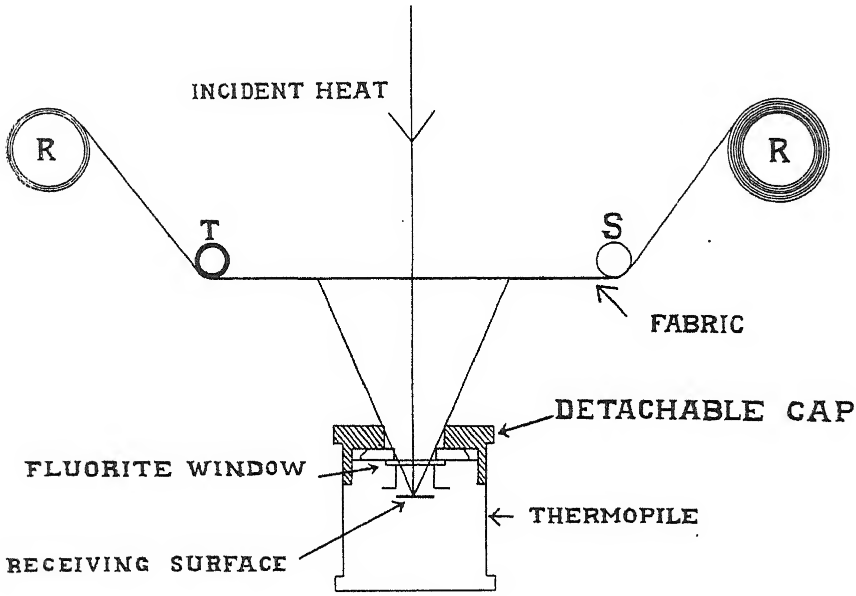

FIG. 4

In the present series of tests, the deflection due to transmitted heat is observed at intervals of one inch along the length of the fabric (corresponding to one turn of the rubber-covered roller), twenty-eight observations being taken successively on each fabric. Before and after each set of observations the deflection due to heat received by the thermopile is observed when exposed direct to the source of heat.

For each section of the fabric tested, the percentage heat transmitted P is calculated as follows—

$$P = \frac{\text{Deflection due to heat received through fabric}}{\text{Deflection due to heat received direct}} \times 100$$

If the relative positions of thermopile, fabric, and source of heat remain unaltered, the percentage P may be employed to compare the transmitting powers of fabrics. In order to indicate the variation from point to point along a fabric, a curve may be plotted in which P is ordinate and the distance along the fabric abscissa. Such curves are given in Fig. 5.

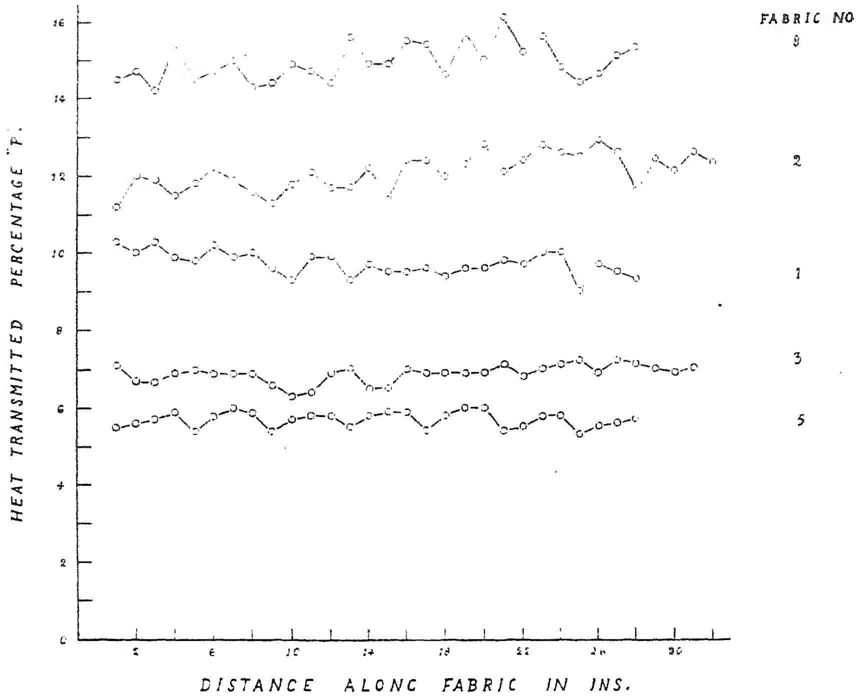

FIG. 5

Effect of the Moisture Content of a Fabric on the Transmission and Reflection of Heat

If the results of tests on fabrics are to be applicable to the conditions under which they are employed in actual practice, account must be taken of the effect of the moisture content on the transmission and reflection of heat. The influence was studied with fabrics conditioned by allowing them to come into equilibrium with atmospheres of known relative humidities, beginning with the fabrics in the dry state and continuing in definite stages to the state of saturation.

Transmission of Heat at Different Relative Humidities.—In this study four types of fabrics were employed (Tables I. and II.) and tested with the arrangement previously described and indicated in Fig. 4, as follows. Specimens of each fabric $2\frac{1}{2}$ inches wide and 7 inches long, cut with the selvage parallel to the length of the specimen, are joined in pairs, the two pairs being separated by a strip of paper in which a circular hole 2 inches in diameter is cut. The compound strip is wound on the rollers RR, and passes over the bar S and the rubber-covered roller T. The same portion of the fabric may be brought into position over the thermopile as required, by counting the number of revolutions of the roller T from the zero position of the fabric. Each specimen is tested four times at intervals of 1 inch along the length of the strip, the same portions of each specimen being tested at the different humidities so that the factors obtained for heat transmission at the different relative humidities are comparable. The fabrics remain throughout the whole series of tests in the same relative positions on the rollers, and the furnace is not disturbed. The radiation is admitted through a thin glass

window, the remainder of the apparatus being screened as previously described. The fabrics are first tested in the dry state, the drying being accomplished in five days by placing in the test chamber trays containing phosphorus pentoxide, replenished after the first day. The method adopted for the production of atmospheres of definite relative humidities was that of maintaining the glass vessel in which the fabrics are placed, at a fixed temperature of 20° C., and circulating air which had been conditioned by passage through a series of six wash bottles containing solutions of sulphuric acid giving the required vapour pressures. The solutions were tested before and after use with a hydrometer, and the relative vapour pressure found from the tables of density given by Kaye and Laby[1], and from the vapour pressure curves given by Wilson.[2] A U-tube packed with glass wool prevented particles of the acid solution from entering the glass vessel, and a sulphuric acid trap prevented diffusion of water vapour against the stream of air maintained by means of a filter pump. The moisture content of the fabrics is that due to absorption. The least period employed for the attainment of equilibrium was 24 hours, this period being considerably exceeded on two occasions.

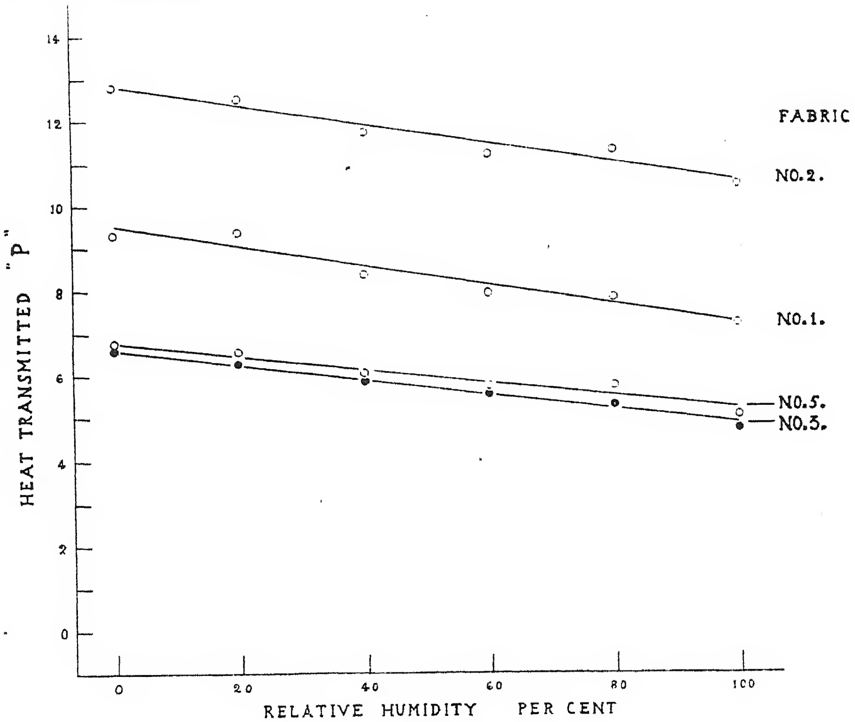

FIG. 6

Results of tests are indicated in Fig. 6 by plotting heat transmitted, *P*, as ordinate against relative humidity per cent. as abscissa. The percentage *P* of heat transmitted is the mean of the four determinations on each specimen of fabric. A longer length of each fabric was not tested because in each case the fabric would be coiled on the rollers RR to a greater extent, and equilibrium would not be readily attained. The accuracy of the separate determinations is not very great owing to the comparatively large change in

the factor P from point to point along the length of the fabric (indicated in Fig. 5), and consequently a small error in setting the position of the fabric induces a larger error in the determination of the factor P. At the end of the series of tests the fabrics were dried and tested again. All showed a slight increase in heat transmitted, which is probably due to the stretching of the fabrics, since in the course of the series of tests they are wound from one roller on to the other a large number of times.

The relation between the relative humidity of the atmosphere with which the fabrics are in equilibrium and the heat transmitted P is approximately linear for the four fabrics tested.

The chief feature to be remarked is that if the fabrics are arranged as in Table I., the percentage decrease in P (expressed as a percentage of the heat transmitted in the dry state) going from the state of dryness to that of saturation, is found to increase as P decreases.

Table I.

Fabric Number	"P," Dry State	% Decrease in P
2	12·8	17·2
1	9·5	21·5
5	6·8	25·0
3	6·6	27·3
		Mean 22·7

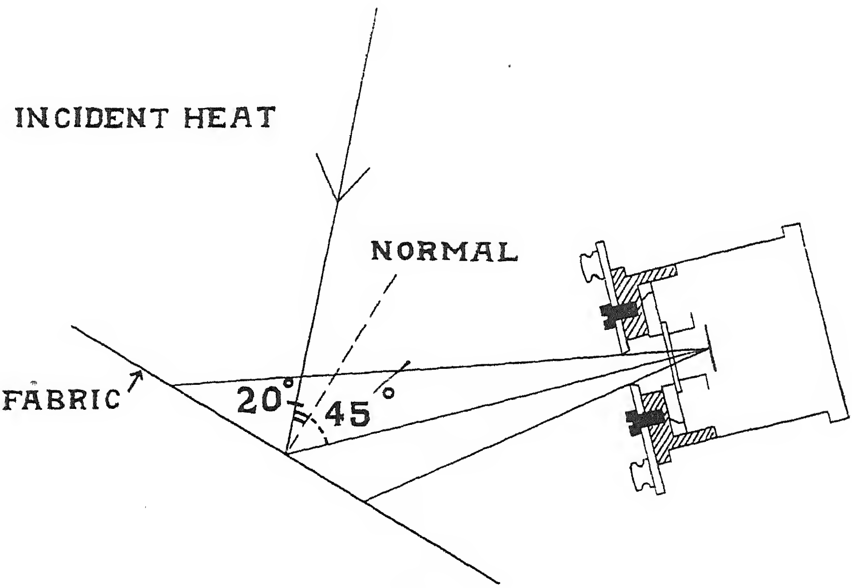

FIG. 7

Reflection of Heat at Different Relative Humidities.—An arrangement similar to that indicated in Fig. 7 is used for determining the intensity of reflected heat, the angles of incidence and reflection remaining fixed. The thermopile is placed a short distance from the surface of the fabric on which the radiant heat is incident, so that the angle of reflection of radiant heat falling on the centre of the fabric is 45°. The receiving surface of the thermopile is protected by a cap which possesses a slit 4 millimetres wide and 8 millimetres long, the length of the slit being perpendicular to the plane of

incidence. The fabric to be tested is mounted on a glass plate, the fabric being backed by a sheet of dull black paper. A mask of similar paper is placed over the fabric, so that a circle of radius $2\frac{3}{4}$ inches remains exposed. Since the thermopile cannot be placed in such a position that it receives heat direct from the furnace, the intensity of heat reflected by the fabric is compared with that reflected by a matt white screen of opal glass. This screen may be lowered into position as required just over the fabric, since it is secured to a pivoted arm. The angle of incidence is 20°. The arrangement is enclosed in a glass vessel, the usual precautions as to screening and temperature control being observed. It is assumed that the reflection of heat from the glass screen is unaffected by changes in relative humidity of the surrounding atmosphere. It was only possible to test one fabric at once, and in view of the time occupied by a complete test, one was considered sufficient to indicate the magnitude of the effect.

At each relative humidity four tests are made, comparing the reflection of heat from the fabric with the reflection from the standard surface, the mean of the four tests being recorded as a measure of the intensity of reflected heat. The results of tests are shown in Fig. 8, in which intensity of reflected heat is plotted against relative humidity per cent. of the atmosphere with which the fabric is in equilibrium.

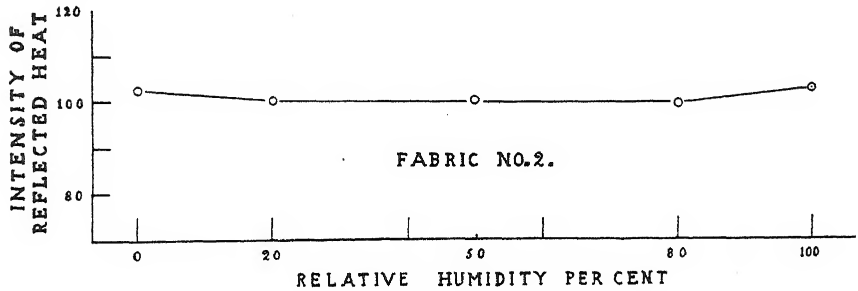

FIG. 8

The maximum change in intensity of reflected heat between the different humidities is hardly significant, being only slightly greater than the experimental error. The whole change is small, and is of far less importance than in the case of heat transmission.

The effect of change in relative humidity may be expected to be the same on the total amount of heat reflected as on the intensity of heat reflected in any one given direction.

Results of Transmission of Heat Experiments

The fabrics tested were bleached white goods supplied as being types exported to the tropics. All the available particulars are given in Table II., and point paper diagrams illustrating some of the types of weaves are given in Figs. 9, 10, and 11, in which a blank space represents the warp passing over the weft on the surface of the fabric. The strips tested were cut with the length parallel to the warp threads of the fabric, and were dried before testing for at least two days over phosphorus pentoxide. The results are collected in Table II.

There exists, as might be expected, a considerable variation in the amount of heat transmitted by the different fabrics, one transmitting almost five

Table II.

Fabric Number	Ends per Inch	Counts of Warp	Picks per Inch	Counts of Weft Yarn	Type of Cotton	Type of Weave	Market	Finish (All Fabrics Finished White)	Weight in Grams of Approx. 25 sq. Inches of Fabric	% Loss in Weight after 1 hour's Washing	Heat Transmitted Percentage "P" Mean of 28 Tests			% Mean Deviation of "P" before Washing
											Before Washing	After 1 hour's Washing	After Prolonged Washing	
1A	73	36	81	38	American	Plain	India	Starch filled, well beetled, and calendered	1·44	1·4	9·8	11·6	12·7	2·6
2A	72	36	68	38	American	Plain	India	—	1·29	3·1	12·1	13·2	14·0	3·2
3A	100	20	54	24	Best American	See Fig. 9	Far East	Chalk, clay & starch filling, well singed	2·07	7·0	6·9	8·0	9·0	2·3
4A	53	36	55	54	Low American	Plain	Burma	Dextrin, clay and glycerin filling	1·15	36·4	9·8	28·9	29·3	2·8
4AA	—	—	—	—	—	—	—	—	—	—	10·0	27·7	—	3·2
5A	72	30	79	36	Low Amer.	Plain	China	Filled, well singed	2·27	33·2	5·7	11·4	13·1	3·1
5AA	—	—	—	—	—	—	—	—	—	—	6·4	11·2	—	2·6
6A	84	80	63	78	Good Egyptian	See Fig. 10	China India Argentina	No filling, singed	1·24	3·6	12·6	13·9	14·4	2·6
7A	26 52	50 32	77	32	Super Combed Egyptian	See Fig. 11	—	No filling	1·38	1·1	14·0	13·1	12·2	2·2
8A	96	55	97	55	Egyptian	Plain	—	No filling	1·20	1·2	14·9	13·9	13·0	2·6
9A	119	78	131	122	Egyptian	Plain	—	No filling	0·93	1·6	18·4	16·8	15·7	2·6
10A	112	120	117	132	Egyptian	Plain	—	No filling	0·68	1·5	27·4	25·0	22·8	2·6

$$P = 100 \times \frac{\text{Galvanometer deflection due to heat received through the fabric}}{\text{Galvanometer deflection due to heat received direct}}$$

times that of another. This is due to the difference in construction of the fabrics involving such matters as filling, amount of cotton per unit area, weave &c.

It will be noted, however, that there is considerable variation in heat transmitted, from point to point along the length of the fabrics (see Fig. 5), but it is obvious that the percentage mean deviation of P which varies from 2·2 to 3·2 does not depend on the amount of heat transmitted (Table II.).

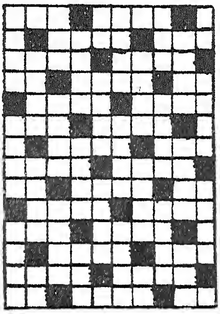

FIG. 9

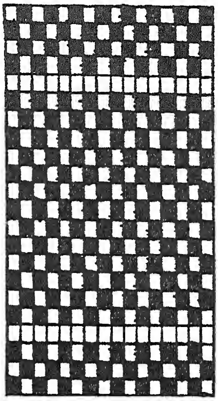

FIG. 10

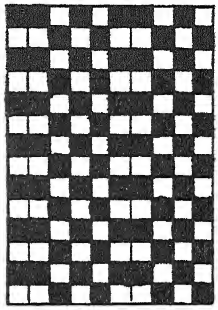

FIG. 11

With regard to the details of the fabrics indicated in Table II., Nos. 3, 4 and 5 are more or less heavily filled. An idea of the amount of filling which is removable by washing is obtained by weighing samples (about 25 square inches in area) before and after boiling for half an hour in soap solution and half an hour in clean water. The fabrics are dried in an oven, maintained at 105° C., previous to weighing. The percentage losses in weight (expressed as a percentage of weights before washing) are given in Table II., together with the weights of the various samples of fabrics previous to washing. These weights give an approximate indication of the relative weights of the different fabrics.

The effect of washing on the transmission of heat has also been determined, using in this instance a gas-filled electric lamp instead of the furnace as the source of heat, since equilibrium was more rapidly reached. The fabrics were tested for heat transmission after one hour's washing as previously described, and then after prolonged washing, usually 20 hours in soap solution. It will be noted from Table II. that fabrics Nos. 4 and 5, which lose in weight on washing a considerably greater amount than the other fabrics, show the greatest increase in heat transmitted. This is apparently due to the removal of filling matter. Both fabrics are entirely changed in appearance, especially No. 4, which becomes a mere rag.

In connection with the discussion of these results, the remarks of Band[3] are interesting. Referring to the heavily filled cheap type of cotton shirting used in India, he states that "the coolie class who wear shirts made of this cloth rarely wash them, and the starch or china clay keep them warm or cool as the case may be." The writer justifies the manufacture of such goods in that the market is extended owing to the cheapness of filling material as compared with cotton, the filling in addition changing the fabric like

a rag into quite a presentable material. It is obvious, however, that a fabric consisting chiefly of filling is equal in heat protective value to the average unfilled fabric only so long as it remains unwashed.

With fabrics Nos. 7, 8, 9, and 10 the result of washing is to cause a decrease in the amounts of heat transmitted. Since all four fabrics were without filling, this decrease can only be ascribed to shrinkage. The effect is not very large, and is not observed with the other six fabrics. This may be due to incomplete removal of filling matter at the first washing process, or to the fact that the six fabrics have reached the limit of shrinkage during previous treatment.

Of the fabrics tested, a heavy type such as fabric No. 3 appears to be most suitable for use as clothing in the tropics, since in addition to the small amount of heat transmitted even after prolonged washing, the heavy fabric affords better protection against possibility of chill.

It will be noted that although fabric No. 1 transmits almost twice as much heat as No. 5 before washing, after prolonged washing there is little difference. The two fabrics are similar in construction as regards the number of picks and ends per inch and counts of warp and weft yarn.

Further work on the lines of the present investigation will consist in the development of a method for determining the total amount of heat reflected from a fabric and an examination of the various processes which go towards the making of a finished fabric, so that the essential features of the best type of fabric for use as clothing in the tropics may be determined.

Mr. H. Wardle has rendered valuable assistance in taking observations during the progress of the work.

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51—THE MEASUREMENT OF THE RESISTANCE OF YARNS TO ABRASION

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INTRODUCTION AND SUMMARY

The measurement of the abrasive quality of yarns is of recognised importance in relation to fabrics and also in reference to weaving, where abrasion is severe, so that abrasive quality must constitute an important aspect of light sizing. Its application where threads are used as for protecting and insulating electrical conductors is apparent.

It is the object of this paper to describe how abrasion tests may be conducted and in what manner and with what precautions the results are to be interpreted.

The abrasive quality of materials is not a property which can be defined in terms of recognised measurable properties of the substance, and probably depends on many distinct physical characteristics contributing in unknown proportions. It seems probable, indeed, that the relative importance of the parts played by the various properties may vary with the nature of the abrasion so that the properties principally determining the abrasive quality may not be the same for smooth as for rough abrading surfaces.

For experimental purposes it is necessary to simplify the manner of applying abrasion so as to reduce to a minimum the number of variables on which the results depend, as only in this way can experiment be made more significant, more economical, and more interpretable than practical experience. For the widest utility, the experiments should retain the essential feature of all practical cases of abrasion and as few of the variable or accidental features as possible. By this means the nearest approach is made to the measurement of a fundamental property. Any test of abrasive quality, however, must for the reasons given yield arbitrary results, the value of which can only be determined by reference to experience. If the results of experiment lead to a fairly accurate forecast of the behaviour of the materials in practice, that is as much as can be expected of a test of abrasive quality.

Although the actual manner of applying abrasion must necessarily be arbitrary, strict uniformity in the essential conditions throughout the experiments is as necessary in this as in any more fundamental measurement. In the present work therefore the abrading surfaces were of polished steel to ensure uniformity in the testing machines. The tests thus represent the case of gradual but prolonged abrasion, and it is recognised that the case of rapid abrasion on rough surfaces may be quite distinct. Of the two, the former seems the more general, since abrasion against rough surfaces is usually avoided.

Some arbitrary form of test having been decided upon, the principal difficulty was in the presentation and interpretation of the results of experiment. Tests were made on single threads, as this seemed a necessary

condition for uniformity of treatment and any rational interpretation of the results. Two methods of applying abrasion were employed. In one case single loaded specimens of yarn were reciprocated vertically so as to bear against sets of fixed steel pegs, and in the other case the loaded threads were inclined over a steel shaft the rotation of which produced abrasion in the small region of contact between the threads and the shaft.

Two methods of experiment were investigated—(1) subjecting all the specimens to a definite amount of rubbing and measuring the reduction in mean strength, and (2) determining the number of rubs necessary to break each specimen.

In the first case, owing to the high variability of yarn, it was not possible to obtain much reduction in the mean strength, and the precision of the measurement was small, so that a prohibitive number of tests would have been necessary to distinguish different sets of conditions. The method was therefore abandoned as impracticable.

In the second case it was found that the arithmetic mean of the number of rubs endured by each specimen was misleading, but that the arithmetic mean of the logarithms of the numbers of rubs, or the geometric mean, provided a rational presentation of the results. This conclusion was reached as a consequence of the observation that the logarithm of the numbers of rubs for all the specimens of a sample formed a frequency distribution not differing greatly from the normal frequency distribution, whereas the numbers of rubs were very extended in the direction of high values, so that there was no theoretical justification for the use of the arithmetic mean, which would be unduly influenced by a few of the strongest specimens.

The fact that both the breaking loads and the logarithms of the numbers of rubs formed approximately normal frequency distributions suggested a relation between the strength of a specimen and the number of rubs required to fracture it. This relation was determined graphically from the frequency curves for the breaking loads and abrasion tests on the assumption that specimens of one sample subjected to abrasion would break in order of strength. The relation, expressed graphically, between the strength and the logarithm of the number of rubs (log. N) was found in some cases to be represented by a straight line, whence it could be inferred that a given increment of log. N was associated with an increment of strength which was the same for all values of the strength, and hence typical of the sample as a whole. The relation did not, however, hold with sufficient exactness and generality to provide a basis for practical testing.

A somewhat similar assumption was employed in an attempt to relate strength and log. N by an arbitrary analytical method, with a similar result.

It was finally concluded that since, in estimating the value of abrasion tests, reference to experience would in any case need to be made, and that this correlation would be simplified by the simplest and soundest presentation of the experimental results, it would be preferable to keep the abrasion results and breaking loads distinct rather than endeavour to include them in a single quantity by using certain assumptions which might or might not conform with actuality.

Although, however, the best practical form in which the results of abrasion tests are to be presented is the mean of the logarithms of the numbers of rubs endured by the specimens, the attempts to establish a connection between

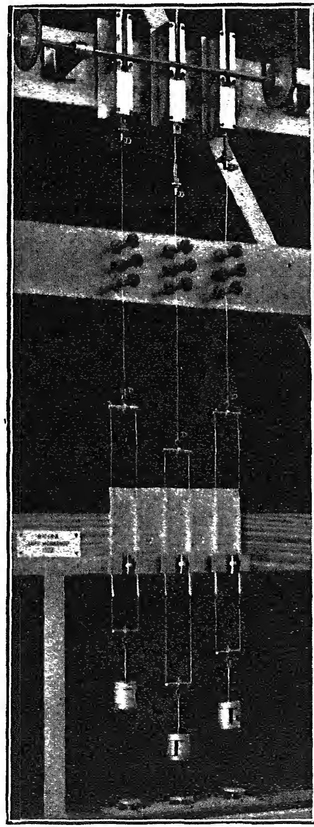

FIG. 1

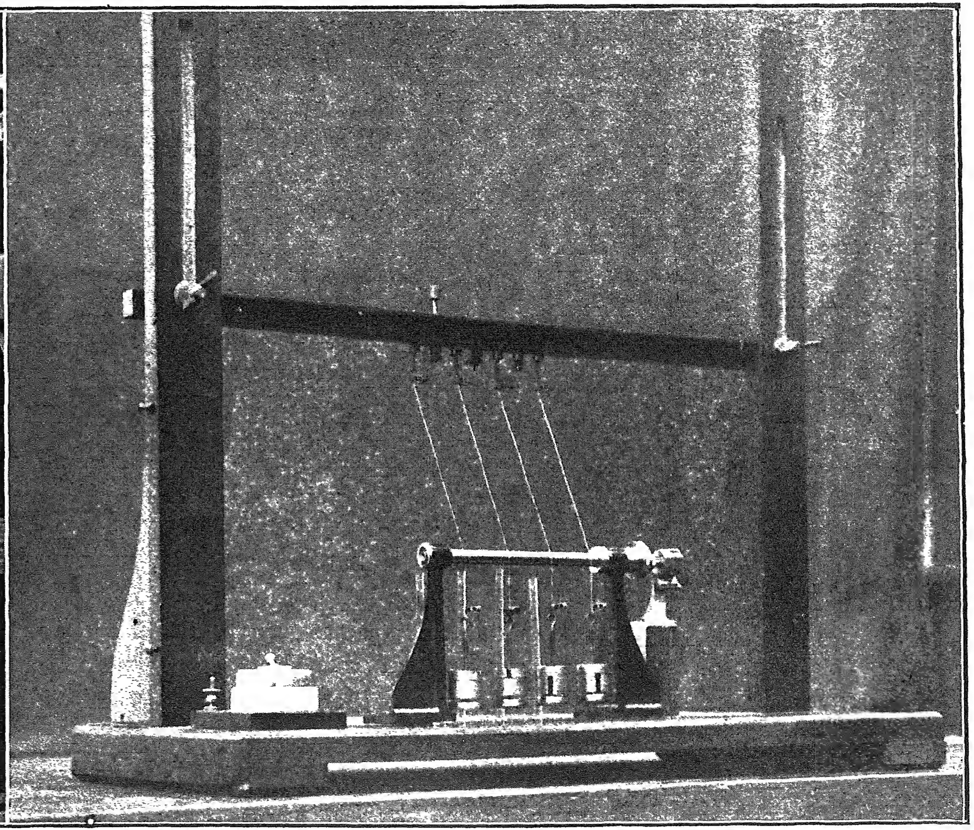

FIG. 2

the strengths of different specimens of a sample and their performance on the abrasion test may not be without interest, and are therefore included in the paper.

EXPERIMENTAL

The Oscillating Stress Tester previously described,[1,2] was readily adaptable for abrasion testing, as it contained provision whereby single loaded specimens of yarn could be reciprocated vertically at speeds up to 130 revolutions per minute over a distance of 5·70 cms. Easily detachable grips facilitated mounting specimens of unsized yarn, clamped before cutting to prevent loss of twist, while untwisting during the test was prevented by a bifilar attachment of the load, each thread working in a glass tube. Twelve specimens could be mounted together, and a revolution counter indicated the number of cycles performed.

The abrasion attachment (Fig. 1) is a girder passing horizontally across the machine and provided with three rows of case-hardened steel pegs projecting from its vertical face. Threads hanging from the grips just touch the pegs in the top and bottom rows, and the middle peg is traversed to one side. Suitable adjustments are provided for the girder as a whole and for the separate pegs, so that the settings can be made accurately and any portion of the surface of the pegs used in order to prevent undue local wear. In a test, a thread hanging from a grip passes to one side of the corresponding top and bottom pegs and round the opposite side of the displaced middle peg, and therefore when reciprocated is abraded by the pegs. The pegs were cleaned from time to time by rubbing with a strip of soft leather moistened with benzene and polished with rouge powder, and finally with a clean strip of leather.

Some experiments were also carried out with an apparatus in which the abrasion was applied by the rotation of a steel shaft, cleaned and polished as above, over which the loaded threads passed from grips arranged parallel to and above and somewhat to the rear of the shaft (Fig. 2). The shaft was rotated by a belt driven from a small electro-motor, its motion being upward at the place of contact with the threads. Four threads could be tested together, the number of rotations being given by a counter. The essential measurements are as follow—

Oscillating Stress Tester—

Diameter of steel pegs	=0·67 cms.
Interval between rows of pegs	=1·90 cms.
Throw of cranks	=5·70 cms.
Approximate maximum speed of thread	=9·0 cms./sec. at 30 r.p.m.
Set of middle peg	=4·0 mms.

Rotating Shaft—

Diameter of shaft	=1·11 cms.
Surface speed	=55-70 cms./sec.

Measurement of Abrasive Quality by Reduction in Mean Strength

In this method of experiment the procedure was to subject all the specimens in turn to a definite number of rubs under the same conditions (of load &c.), and to compare the breaking loads of the specimens so treated with the breaking loads of an equal number drawn from the same bulk sample. Breaking loads were measured with the Baer Single Thread Tester, and about twenty specimens each from the rubbed and unrubbed

samples were tested alternately to allow for any progressive changes, e.g., in atmospheric conditions. A series of tests was carried out in which the only quantity varied from one test to another was the number of rubs, the yarn, load, speed and settings of the machine being the same in all the tests. The load used was 44·7 grams, as high a load as could safely be used without producing too great a proportion of breaks, since the method requires that the broken specimens may be neglected without prejudice to the remainder forming a fair sample of the bulk, and this can only be ensured by having to neglect as small a number of broken specimens as possible. Thus in a preliminary test, after 1,000 rubs under a load of 73·0 gms., 25% of the specimens had broken, and it would not be justifiable to compare the remainder with the unrubbed specimens on the assumption that both were random samples of the bulk.

The results of this series are given in Table I.

Table I.—Oscillating Stress Machine

Load=44·7 grams. Length of specimens=9 inches.
Speed=120 r.p.m. Yarn=5s. Number of specimens in each test=140.
U=Unrubbed. R=Rubbed.

Test	Number of Rubs	Treatment	Number of Breaks in Abrasion Experiment	Mean Breaking Load	P.E. of Mean Breaking Load	% Deterioration	P.E. of % Deterioration
1	1,000	U	—	9·630	·0918	6·81	1·30
		R	2	8·974	·0913		
2	500	U	—	9·556	·0884	5·03	1·23
		R	0	9·075	·0827		
3	2,000	U	—	9·503	·0892	8·09	1·23
		R	4	8·734	·0838		
1a	1,000	U	—	9·533	·0830	8·04	1·24
		R	0	8·767	·0900		
4	3,000	U	—	10·013	·0927	6·61	1·27
		R	4	9·351	·0929		
5	200	U	—	9·720	·0922	2·53	1·30
		R	0	9·474	·0887		
6	1,500	U	—	9·883	·0933	5·76	1·32
		R	2	9·314	·0960		
6a	1,500	U	—	8·873	·1028	8·64	1·40
		R	3	8·106	·0810		
3a	2,000	U	—	9·107	·0947	6·09	1·33
		R	2	8·552	·0825		

It will be seen that whilst the numbers of breaks are not high enough to invalidate comparison between the rubbed and unrubbed samples, any attempt to increase the depreciation of strength by increasing the load would probably have led to an inadmissible increase in the breakages. The conditions employed must therefore have been very nearly as stringent as the method would allow. The percentage deterioration, calculated from the formula

$$\frac{\text{Mean strength of unrubbed—Mean strength of rubbed}}{\text{Mean strength of unrubbed}} \times 100$$

is, however, in no case very large, while the probable error of this quantity is relatively very high. The conclusion is that the method only permitted

of obtaining small reductions in the mean strength so that very large numbers of tests would have been required to have established even whether the differences in 500 and 3,000 rubs were significant. The method did not therefore promise to be of use in differentiating between the abrasive quality of different yarns.

An interesting deduction can, however, be made from these results. The load was so small that the breaking load even of the weakest specimens must have been considerably above the value at which rupture occurred. If the strength of all specimens were reduced by approximately the same amount by any given number of rubs, a greater mean reduction of strength would probably have been observed. From this it may be inferred that even when three or four specimens had been weakened to the breaking point, the strength of the remaining specimens was reduced by a less amount.

Before abandoning the method it was decided to eliminate as far as possible one undesirable feature, viz., the cyclic variation of tension in the specimens resulting from the variable speed of the load supported by the threads, which might have contributed to the tendency for specimens to break but not to the general weakening. With the Oscillating Stress Tester performing 120 cycles per minute, the cyclic variation of tension due to the inertia of the load was about 92% of the steady load. By reducing the speed to 30 r.p.m. in all subsequent experiments, this variation was reduced to 1/16th of its value at 120 r.p.m., viz., to about 6%, a value which was considered unimportant.

A further series of tests was now made, the results of which are given in Table II. With the load of 101·3 gms. the number of breaks was inadmissibly high in all cases except that of 200 rubs, where, however, no deterioration was observable. With the higher load of 129·6 gms. the breakages were far too numerous even after only 200 rubs, so that it seemed by no variation of load and number of rubs could this method of experiment be adapted to the measurement of abrasive quality, and it was accordingly abandoned.

Table II.—Oscillating Stress Machine

Speed = 30 r.p.m. Yarn = 1s.
U = Unrubbed. R = Rubbed.

Test	Load (grams)	Number of Rubs	Treatment	Number of Specimens	Breaks in Abrasion Experiment %	Mean Breaking Load of Survivors	% Deterioration
1	101·3	200	U	140	—	9·15	Nil
			R	140	1	9·19	
2	129·6	200	U	140	—	9·22	1·05
			R	204	31	9·12	
3	101·3	2,000	U	140	—	9·01	3·4
			R	152	50	8·71	
4	101·3	1,000	U	87	—	9·47	2·6
			R	88	19	9·23	
5	101·3	500	U	140	—	9·30	2·9
			R	141	21	9·03	

An observation which has since been made, however, somewhat weakens these conclusions. The extent of the region of rubbing was only about half the length of the test pieces employed in the measurements of breaking

load, so that apart from the effect of rubbing, and assuming that in the Baer test the place of rupture is equally likely to occur at every point along the length of the specimen, then, in measuring the strength of the rubbed specimens half of the breaks would occur at a place which had not been rubbed and the measurements of strength for these specimens would not show any difference due to the previous rubbing. Actually the effect of the rubbing would be to predispose the yarn to break in the rubbed region, so that the proportion of specimens for which the effect of rubbing is not shown in the strength determinations would be less than half. The objections would therefore still be serious even if the length of the Baer test pieces were the same as the rubbed portions on the abrasion test. In particular, although the percentage deterioration might be slightly increased, its precision would remain about the same, so that prohibitive numbers of tests would still be required. There is in addition the consideration that in a comparison between various yarns the conditions in the abrasion experiment would have to be adjusted by means of preliminary tests to suit the poorest of the yarns to be examined, and the method is clearly not likely to be of practical value.

Estimation of Abrasive Quality by the Number of Rubs required to Break all the Specimens of a Sample

This method consists in keeping the testing machine fully charged, replacing specimens as they break by fresh ones and noting the number of rubs endured by each. The principal experimental difficulty was the breaking of a few specimens at places outside the region of rubbing, the significance of which was that the breaking of some specimens might not be a pure wearing effect but a time breakage under a prolonged tension. The load was adjusted so that the proportion of these irregular breaks was small, as they were more numerous with heavy loads, and they were neglected from the calculations.

The greatest difficulty was in the interpretation of the results, for though some specimens broke after a few rubs others endured such abnormally high numbers of rubs that if the mean of the numbers of rubs were taken as a criterion its value would be unduly influenced by these strongest specimens. The impression was formed that the significance of one rub was not a definite quantity but depended on the number of rubs which had preceded it. The results were not therefore presented by the arithmetic mean of the numbers of rubs, but the whole course of the experiment was presented graphically by means of "survivor" curves in which the ordinates gave the proportion of specimens remaining unbroken after any number of rubs given by the abscissæ. Some typical survivor curves are shown in Figs. 3, 4, and 5.

In Fig. 3 are presented the results of two experiments, D_1 and D_3, performed at different times but otherwise made under the same conditions. From a bulk sample of yarn—a section of a warp—threads were taken one by one and arranged consecutively into a number of samples which were therefore as nearly identical random samples of the bulk as possible. Four of these samples were employed in the tests D_1, D_3, two samples in each test. Thus in D_1, the testing machine was loaded with an equal number of specimens from each of two of the samples and set in operation. When a thread of one sample broke it was replaced from the other sample, and this process was continued until both samples were exhausted, so that at

the end of the experiment equal numbers from each of the two samples had been tested on every engine. Any small differences between the engines and any atmospheric effects would therefore have affected both samples equally. The results for each sample in each of the tests D_1 and D_3 are

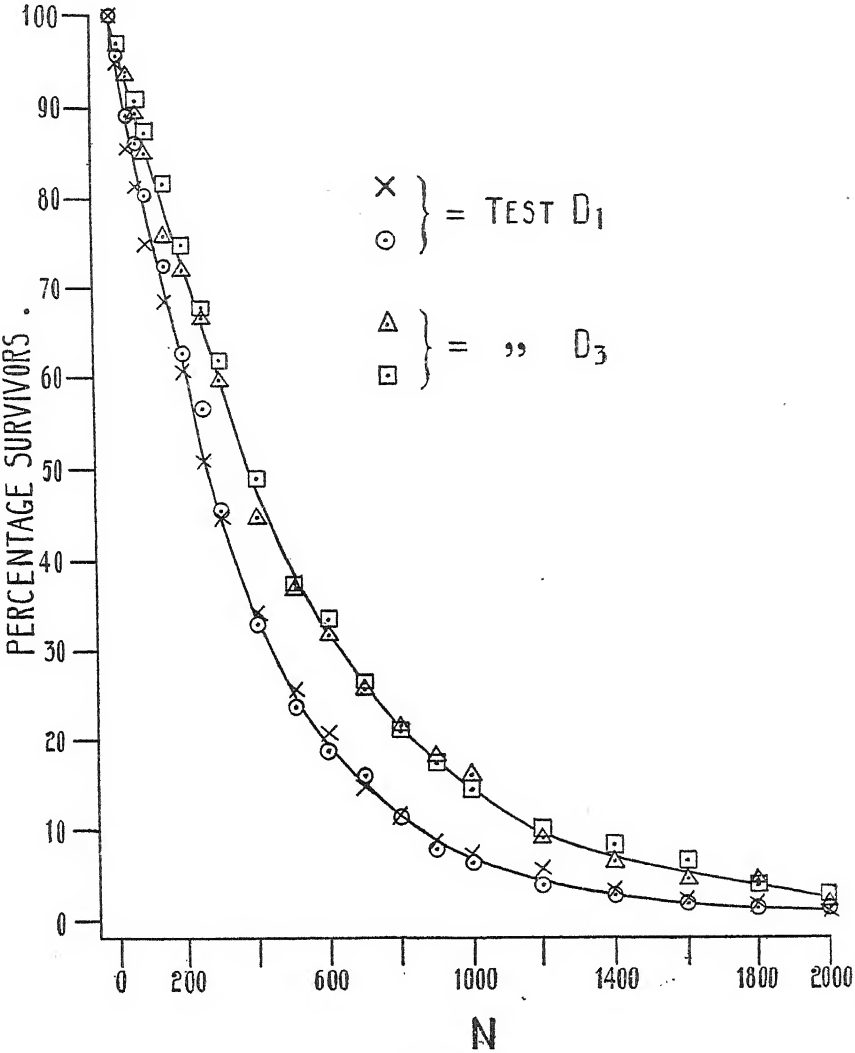

FIG. 3

plotted separately in Fig. 3, but only one curve is drawn for each experiment, as the survivor curves for the two samples in each experiment are for practical purposes coincident, showing that the method of preparation had in fact yielded identical samples. Baer tests on a third pair of the samples likewise gave virtually identical results. There is, however, considerable difference between the results for tests D_1 and D_3, although the samples and the controllable conditions were the same in the two cases, but the tests were made at different times. This difference seems to indicate the influence of atmospheric conditions. Differences are also observed

between the three tests 5, 6, and 7 (see Fig. 5) made at different times under the same controllable conditions.

Comparison between the results of tests expressed as survivor curves is not in general convenient and is of uncertain significance, and the practical

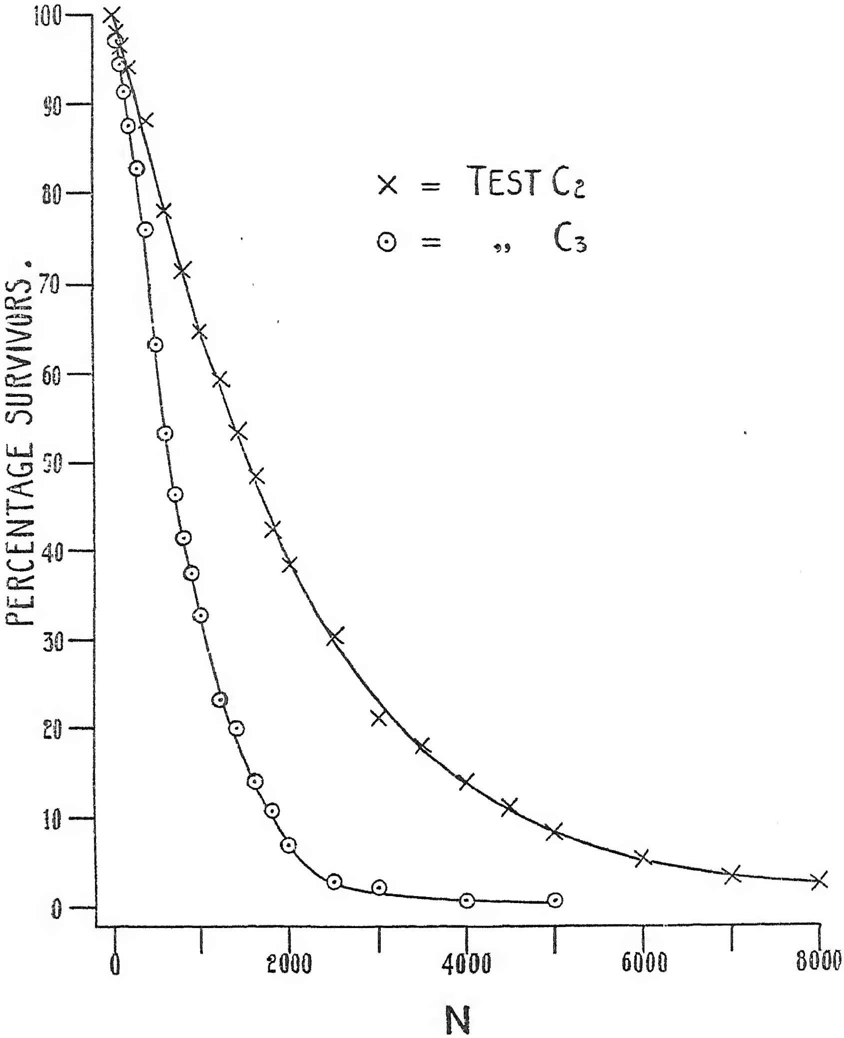

Fig. 4

utility of abrasion tests would be seriously limited without some analytical presentation of results. What is required is a simple number conveying a definite idea of the relative abrasive qualities of various yarns. Now it will readily be seen from the shape of the survivor curves in Figs. 3-5 that the arithmetic mean of the numbers of rubs endured by all the specimens of a sample is not such a quantity. The curves tend to become parallel to the oscillation axis, so that the value of the mean is determined very largely by the few specimens which survive to this stage. The mean would thus place great weight on the few strongest specimens, and large differences between samples would be indicated even where the survivor curves

were everywhere almost identical except in this end region, and would not reflect differences of practical significance.

Whereas in the first steep part of the curve a few rubs produce a large number of breaks, in the end flat region the same number of rubs produce

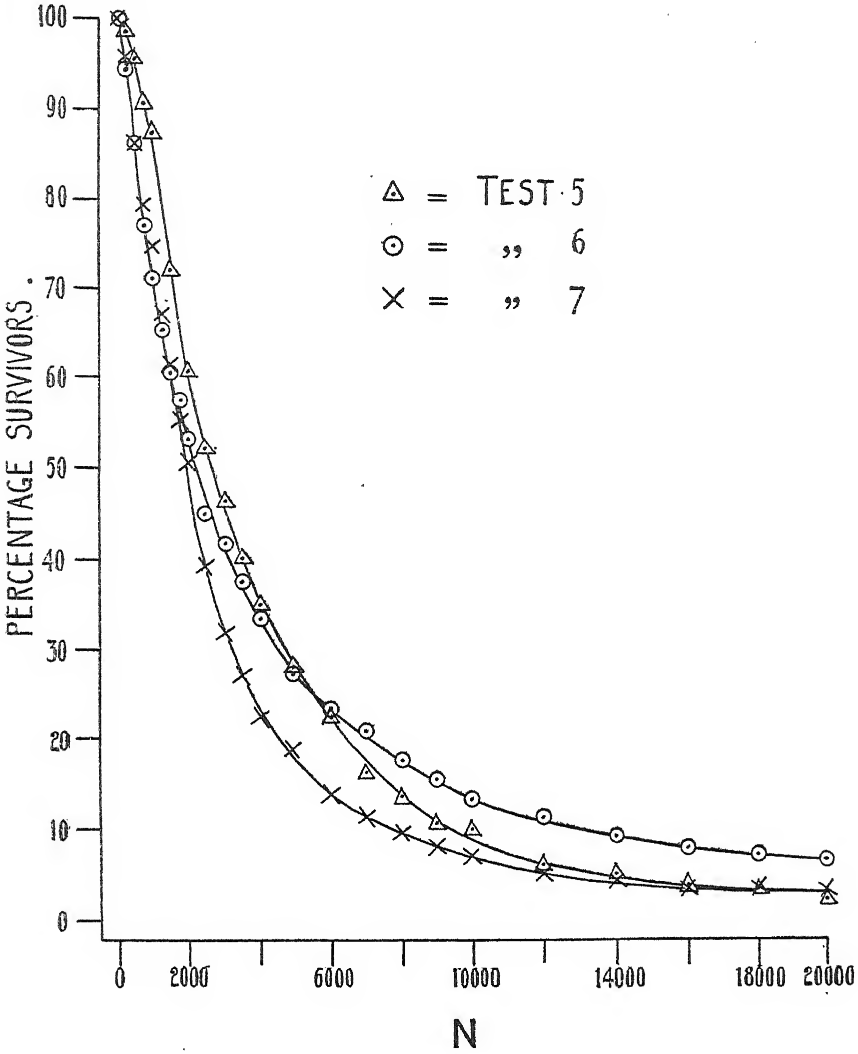

FIG. 5

a very much smaller number of breaks, whence it appears that the effect of a given number of rubs depends on what stage of the test is considered. To express the abrasive quality of a yarn as the mean of the numbers of rubs endured by each specimen would be analogous to expressing the price of articles in shillings if the value of a shilling depended on the number of shillings in the price, or the heights of buildings in feet if the length of a foot were less for high than for low buildings.

Theoretically there is no justification for expressing the results of a series of observations in terms of the arithmetic mean unless the observations

form an approximately normal frequency distribution of magnitudes. The survivor curve for a normal frequency distribution is of the form shown by the plain curve in Fig. 6, which has been drawn from the calculated values for the "normal" distribution, and which will be referred to as the

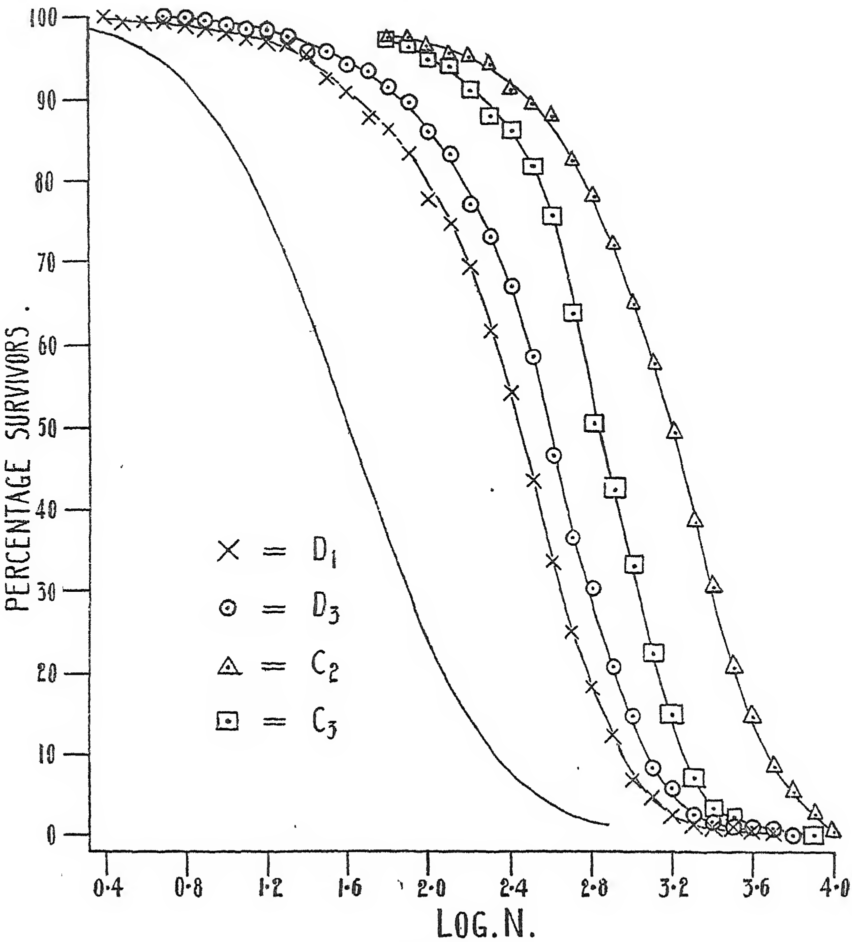

FIG. 6

"normal" survivor curve. Many of the measurable properties of yarn, such as breaking load, yield nearly normal survivor curves, and the arithmetic mean is justly taken as the best value, the most probable value, of the results of measurements on a large number of specimens.

In order to use the arithmetic mean to express the results of abrasion tests it would therefore be necessary to plot the results as survivors, not against the number of rubs but against some mathematical function of the number of rubs such that the resulting survivor curve is of the "normal" form. Comparison between the survivor curves of Figs. 3-5 and the normal curve of Fig. 6 shows that the function must be such that the scale of the abscissæ is contracted more and more as the values increase. One way which suggests itself is by plotting logarithms of the numbers of rubs instead

of the actual numbers of rubs. In this case, for example, values along the abscissæ on the number of rubs survivor curve represented by lengths proportional to 100, 1,000, 10,000 would on the logarithmic survivor curve be represented by lengths proportional to 2, 3, and 4, thus effecting a con-

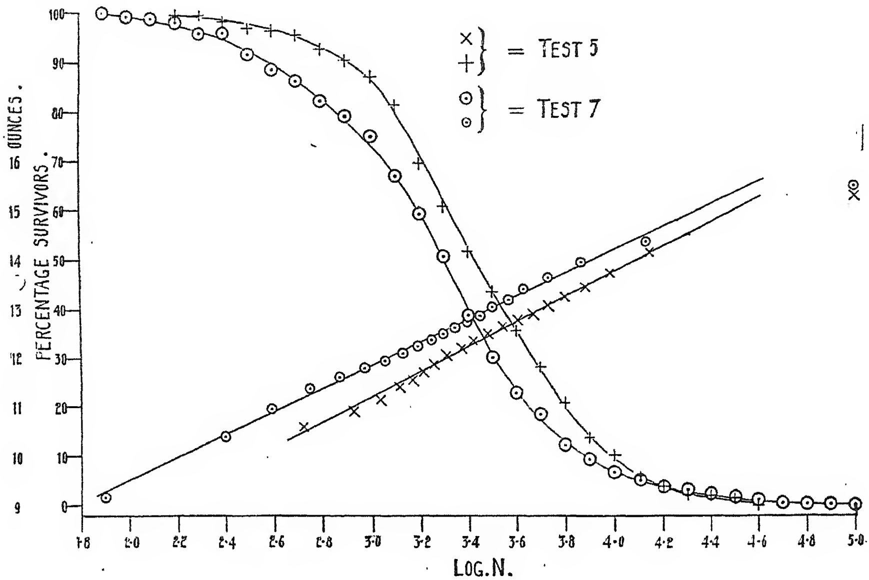

FIG. 7

traction of the nature desired. This method of conversion has been tested for the results of a large number of experiments on both the oscillating stress and rotating shaft testing machines. Some typical logarithmic survivor curves for the former are given in Fig. 6, which refer to the same measurements as the plain survivor curves of Figs. 3 and 4. In Fig. 7 two logarithmic survivor curves referring to rotating shaft tests may be compared with the plain survivor curves for the same tests included in Fig. 5. The logarithmic survivor curves closely resemble the "normal" survivor curve, and it therefore appears that *the results of the abrasion tests can be rationally expressed as a single numerical quantity, viz., the arithmetic mean of the logarithms of the numbers of rubs endured by all the specimens of a sample,* which would be as significant of the abrasive quality as the mean breaking load is of the strength. In all the tests of which details are given in Table III., the logarithmic survivor curves have been drawn and are similar in form to the normal curve, the examples given being typical. The tests cover a wide range of loads and include various yarns, sized and unsized, and tests on both machines, and it may therefore be inferred that the result italicised above is of wide generality and applicable to all cases of the slow abrasion of cotton yarns.

The fact that other properties of specimens of cotton yarn, notably the breaking load, form nearly normal frequency distributions suggests a definite relation between, for example, the breaking load of a specimen and the logarithm of the number of rubs that it will endure. Thus if there is a simple linear relation between breaking load and logarithmic rubs, and if

the frequency distribution of breaking loads is normal, then will the frequency distribution of logarithmic rubs also be normal. There is therefore from the similarity of the survivor curves of breaking loads and logarithmic rubs, some grounds for suspecting a linear relationship between these two properties.

Breaking loads were measured on all the samples, and in every case breaking load survivor curves were drawn in which the ordinates gave the proportion of specimens of strength exceeding the values of the corresponding abscissæ. If the assumption is made that specimens of one sample subjected to abrasion on the whole break in order of strength, the weaker ones first and so on, then it is possible from the abrasion and breaking load survivor curves to deduce a curve in which the abscissæ represent the logarithms of the numbers of rubs endured by specimens of strength given by the corresponding abscissæ. Thus the values of the strength and logarithmic rubs for which there are, say, 60% survivors, can be read from the curves and plotted as one point on the strength-logarithmic rubs graph and additional points can be obtained from the values at other corresponding points of the survivor curves.

Strength-abrasion curves have been drawn in this way for nearly all the tests of Table III., and two examples are given in Fig. 7. In these two cases the relation between strength and logarithmic rubs is well represented by a straight line. The significance of this is that for any pair of specimens in one sample whose strengths differ by a constant amount the logarithms of the numbers of rubs endured also differ by a constant amount so that for all specimens of one sample the amount of abrasion corresponding to unit change of strength is given by the slope of the line referred to the strength axis.

This would evidently be a most useful index of the abrasive quality of a yarn, applying to every specimen, and making possible direct comparisons of obvious significance between different yarns. Although the fundamental assumption, that in the abrasion test specimens of one sample break in order of strength, does not appear capable of direct proof, this linear relation appeared so remarkable as to warrant full investigation. It appeared that the relation did not always hold as well as appears from Fig. 7, which in fact represents two of the most favourable cases. In many instances, especially with the oscillating stress machine, the points fell very closely about two straight lines intersecting near the middle of the range.

If both the abrasion and the breaking load survivor curves were normal, it can be shown that if the strength-abrasion curve were linear its slope would be given by the ratio of the standard deviations or mean deviations for the two frequency distributions, or more generally by the ratio of the standard deviations for any form of distribution provided these were of the same form in both cases. The values of the slope calculated from the mean deviations agree well with the values found graphically in those cases where the strength abrasion relation is linear, thus—

Test	5	7	9	10
Calculated	2·54	2·66	2·53	2·55
Graphical	2·52	2·32	2·73	2·55

Where the strength-abrasion relationship could not be represented by a single straight line, it follows that the frequency distributions for the

breaking load and abrasion measurements could not have been similar; that is, since the breaking load distributions were very nearly normal, the abrasion distributions were not quite normal.

A normal curve was found to give a good fit to the breaking loads in Test D_3, while the abrasion results were well represented by a skew curve. From these fitted curves points on the strength-abrasion diagram were deduced, and gave, of course, a smooth curve, which deviated little from the two straight lines obtained by the usual method.

A third method of deducing the strength-abrasion relationship from the unsmoothed data gave a set of points more widely scattered than in the two previous methods, which could be equally well represented by either the smooth curve or the pair of straight lines.

It was not possible from the data to affirm that either the smooth curve or the pair of lines gave the better representation, but no special significance is to be attributed to the discontinuity implied in the pairs of straight lines since a different method of smoothing the data giving a continuous curve could equally well be adopted. In either case the slope of the strength-abrasion graph could not in general be used as an index of abrasive quality.

Table III.

In addition to this graphical attempt to render the results of abrasion tests independent of the breaking load, an attempt was made to see whether by some simple manipulation of the breaking load and abrasion measurements it was possible to obtain an index which would be the same for every individual specimen of whatever strength, and hence independent of strength. The various steps in the process are set forth in Table III. In each experiment all the observations for both the breaking load and abrasion tests were divided into two parts, each part containing half the total number of observations. In one part were arranged the half of the observations of lower numerical value and in the other the higher values. The mean value for each half was calculated and the results are entered in columns 6 to 9. The one sample had now been divided into two portions, a weaker and a stronger, in both tests. Making now the assumption that the weaker half in the abrasion test are also the ones of smaller breaking loads, then the sample may be regarded as having been divided into two portions, for each of which the mean logarithmic rubs and mean breaking load are known, and the problem was whether by some simple manipulation of the means of the two quantities for each half-sample an index was obtainable which was the same for both halves, and hence true of the yarn as a whole and independent of breaking load.

The mean logarithmic rubs for each half-sample was divided by the corresponding mean breaking load, and the results are entered in columns 10 and 11. The ratio of the quantities in columns 10 and 11 are entered in column 12, where a value unity denotes equality of the indexes for each half sample.

On the whole the values in column 12 do approximate to unity, and so give some support to the arbitrary procedure adopted. In the remaining columns of Table III. the same process of combining breaking load and abrasion measurements is applied to the samples as a whole in each experiment; the means for all the abrasion and all the breaking load measurements are given for each experiment in columns 15 and 13, and in column 17 the ratios of these means are multiplied by the load used in the experiment.

Quite apart from the validity of the intermediate steps, the values in column 17 for any one sample tested under the same load on various occasions should agree within limits determined by the probable errors in column 18, and the first step is to see how nearly this is true. Actually large differences occur even in these cases. For tests 5, 6, 7, and 8 the values of C range from 1·418 to 1·260, a difference of 0·158 whose P.E. is only 0·0117. It is evident that this difference of 12% arises almost entirely from column 15 rather than from column 13, that is, must be ascribed to differences in the abrasion rather than in the breaking load measurements, and is therefore unlikely to be due to bad sampling. Tests 3A and 4B show no significant difference, but between 9 and 10 there is a difference of 8%, which also does not arise from the breaking load tests. Among G_2, G_3, and G_4 the differences are scarcely significant, but in the series C4 (i.), C4 (ii.), D_1, and D_3 the maximum difference is 8%, and occurs between the latter two for which, as described on page T572, the sampling was undoubtedly very good.

In the series C_3, D_2 (i.), D_2 (ii.), and E1 (1s) there is a difference of $4\frac{1}{2}$% between C_3 and D_2 (ii.), but between E1 (1s) and C3 the difference is 10%, but arises partly from column 13, the values in which for the E (1s) tests are notably lower than all the other determinations of breaking load for this sample. In the remaining cases no large differences occur.

It is evident that large differences of the order of 10% in the values of C for the same sample tested at various times under the same controllable conditions may arise from the abrasion experiment and are not attributable to bad sampling. Since the abrading surfaces were of polished steel, it is unlikely that variations in the testing machines were responsible, and the most probable conclusion is that the abrasion experiment was sensitive to atmospheric conditions over which there was no control.

In column 17 the ratio of the mean of the abrasion tests to the mean of the Baer tests is multiplied by the load employed in the abrasion test, the object of the last step being to see whether a simple correction for the different loads employed is possible, since it is obvious that the value of $\bar{A}$ must be inversely dependent on the load.

The rotating shaft tests provide little evidence for or against this correction. In the oscillating stress series of tests the values of C for the same sample appear to be equal within quite narrow limits.

Finally, the values of C for the various samples for the various loads are directly comparable if the assumptions employed are true, so that the quantity C is the ideal index of abrasive quality universally applicable to all yarns tested under any load. It is interesting that the yarns are arranged in the same order of values of C on both the oscillating stress and the rotating shaft machines, but this observation is not very significant.

NOTES ON TABLE III.

Experiments numbered 3A to 12 refer to rotating shaft method. Remainder are oscillating stress tests.

Description of Samples and Methods of Sampling

Sample 5*s*.—28's American sized warp, 13% farina. Specimens taken at random from bulk sample—section of a warp.

Sample 1*s*.—32's American sized warp, $12\frac{1}{2}$% farina. Bulk sample obtained by cutting section from warp. Portions removed from bulk for

the C and E tests and the tests of Table II. The breaking loads for the C tests were those measured for the unrubbed specimens in Table II. For the E tests breaking loads were specially measured by 200 tests on samples 1 and 1s. For the D tests, ten identical samples were prepared by taking threads one at a time from the bulk and arranging them consecutively into ten groups. Baer tests on two of the samples gave identical results, and these values were used for the D tests. Two of these samples were used for the test F1.

Sample 1.—As 1s, but before sizing. Portions removed from bulk for E tests. Specimens picked at random from bulk for test F2.

Sample 78B.—32's Egyptian unsized. One bobbin. In tests 5, 6, and 7 and the G tests, the specimens were cut from the yarn as unwound from the bobbin, a number being used for the abrasion and breaking load test alternately throughout.

Sample 224B, 227B, 234B.—36's Memphis. 3 bobbins. Alternate specimens along yarn as unwound from bobbins for breaking load and abrasion experiments.

Sample Z1.—One cop of weft yarn, alternate specimens along yarn as unwound from cop for breaking load and abrasion experiments.

CONCLUSIONS

Table III. and the discussion relating thereto deal with an attempt to demonstrate from the available data a procedure to obtain an index of abrasive quality for a yarn deduced from abrasion and breaking load tests, holding for all specimens of one sample of whatever strength, and hence independent of strength, so that a comparison between different yarns would be free from any bias resulting from strength differences. There is some support for the procedure, but this does not amount to a demonstration of its validity, and it is in fact based on the assumption that specimens of the same sample break under abrasion in order of strength for which there is no direct experimental evidence. A similar remark applies to any attempt to base a criterion of abrasive quality upon the strength-abrasion diagrams.

Since, for the reasons discussed in the introduction, the indications of the abrasion tests would require to be co-ordinated with experience, the best presentation of the results of experiment should be entirely free from any assumptions which might or might not conform with actuality. Hence it is suggested that results of abrasion tests should be expressed as the mean of the logarithms of the numbers of rubs endured by all the specimens of a sample; for which ample justification has been obtained. Comparison between samples should be carried out under the same load and breaking load tests should be made, since it is at least possible that differences in strength may impart a bias to the abrasion results in favour of the stronger yarn, whereas what may be desired of an abrasion test is some indication of abrasive quality independent of questions of strength.

It seems that any considerable advance in abrasion testing must be in the direction of correlating experimental results with experience. The comparison of good and bad warps, and of differently dressed yarns, might be usefully undertaken.

It does not seem possible to predict directly from laboratory experiment what value abrasion testing may have, since the test is necessarily of an

Table III.

1	2	3	4		5	6	7	8	9	10	11	12	13	14	15	16	17	18
						Mean of Weaker Half		Mean of Stronger Half		Abrasion ÷ Baer								
Test	Yarn	Load in Ounces	Number of Abrasion Tests	Irregular Breaks (omitted from calculations)	Number of Baer Tests	Abrasion (A_w)	Baer (B_w)	Abrasion (A_s)	Baer (B_s)	$\frac{A_w}{B_w}$	$\frac{A_s}{B_s}$	$\frac{A_w}{B_w} \div \frac{A_s}{B_s}$	Mean of Baer Tests ($\bar{B}$)	Probable Error of $\bar{B}$ (r_B)	Mean of Abrasion Tests ($\bar{A}$)	Probable Error of $\bar{A}$ (r_A)	Load × $\frac{\bar{A}}{\bar{B}}$ = C	Probable Error of C
3A	1	4·14	210	4	200	3·355	6·975	4·207	8·555	·481	·492	·978	7·765	·0477	3·781	·0252	2·016	·0180
3B	1	5·10	453	25	200	2·925	6·975	3·841	8·555	·419	·449	·933	7·765	·0477	3·383	·0189	2·222	·0185
4A	1	3·84	215	0	200	3·396	6·675	4·075	8·440	·509	·483	1·054	7·557	·0531	3·738	·0197	1·899	·0167
4B	1	4·14	268	1	200	3·324	6·675	3·950	8·440	·498	·468	1·065	7·557	·0531	3·638	·0162	1·993	·0166
5	78B	5·10	276	0	200	3·091	11·49	3·791	13·26	·269	·286	·941	12·38	·0532	3·442	·0178	1·418	·00959
6	78B	5·10	315	0	200	2·878	11·67	3·830	13·47	·247	·284	·870	12·57	·0540	3·356	·0228	1·362	·0110
7	78B	5·10	316	0	200	2·888	11·54	3·668	13·38	·250	·274	·912	12·48	·0539	3·278	·0185	1·340	·00954
8	78B	5·10	512	0	524	2·753	11·68	3·485	13·55	·236	·257	·918	12·62	·0345	3·119	·0137	1·260	·00663
9	234B	4·12	476	8	497	3·108	5·957	3·824	7·834	·522	·488	1·070	6·897	·0358	3·466	·0141	2·071	·0137
10	234B	4·12	431	10	449	3·441	6·088	4·114	7·830	·565	·525	1·076	6·962	·0349	3·778	·0137	2·236	·0138
11	Z1	2·14	477	1	489	3·780	6·853	4·453	8·262	·552	·539	1·024	7·560	·0272	4·116	·0132	1·165	·00563
12	Z1	3·13	481	6	493	3·573	6·672	4·251	8·208	·536	·518	1·035	7·441	·0293	3·912	·0134	1·645	·00855
C2	1s	3·58	221	↑ Not Recorded ↓	647	2·712	8·036	3·491	10·40	·337	·336	1·003	9·221	·0394	3·103	·0226	1·205	·00941
C3	1s	3·93	230		647	2·462	8·036	3·102	10·40	·306	·298	1·028	9·221	·0394	2·783	·0179	1·186	·00915
C4 (i.)	1s	4·57	237		647	1·967	8·036	2·745	10·40	·245	·264	·929	9·221	·0394	2·357	·0217	1·168	·0119
C4 (ii.)	1s	4·57	239		647	1·864	8·036	2·632	10·40	·232	·253	·917	9·221	·0394	2·250	·0222	1·224	·0120
D1	1s	4·57	405		435	1·963	7·966	2·752	10·59	·241	·260	·927	9·286	·0535	2·359	·0168	1·143	·0106
D2 (.)	1s	3·93	417		435	2·499	7·966	3·229	10·59	·314	·305	1·030	9·286	·0535	2·865	·0155	1·213	·00959
D2 (ii.)	1s	3·93	428		435	2·564	7·966	3·300	10·59	·322	·312	1·032	9·286	·0535	2·932	·0151	1·241	·00959
D3	1s	4·57	407		435	2·142	7·966	2·889	10·59	·269	·273	·986	9·286	·0535	2·517	·0159	1·239	·0107
E1	1s	3·93	237		200	2·585	7·695	3·352	10·11	·336	·332	1·012	8·903	·0725	2·970	·0213	1·311	·0142
E2	1s	2·58	173		200	3·745	7·695	4·258	10·11	·487	·421	1·156	8·903	·0725	4·003	·0172	1·160	·0107
E3	1s	3·58	162		200	2·956	7·695	3·707	10·11	·384	·367	1·052	8·903	·0725	3·333	·0260	1·340	·0151
E1	1	3·93	235		200	1·792	6·975	2·442	8·555	·257	·285	·902	7·765	·0477	2·118	·0183	1·072	·0114
E2	1	2·58	176		200	2·702	6·975	3·505	8·555	·388	·410	·947	7·765	·0477	3·104	·0263	1·031	·0108
E3	1	3·58	167		200	1·997	6·975	2·560	8·555	·286	·299	·957	7·765	·0477	2·280	·0186	1·044	·0107
F1A	1s	3·58	128	2	210	2·870	8·091	3·548	10·49	·355	·338	1·050	9·290	·0702	3·209	·0258	1·237	·0138
F1B	1s	4·25	226	4	210	2·126	8·091	3·106	10·49	·263	·296	·889	9·290	·0702	2·616	·0281	1·197	·0158
F2A	1	3·58	114	6	200	1·908	6·800	2·524	8·460	·281	·298	·943	7·630	·0509	2·216	·0253	1·040	·0144
F2B	1	4·25	339	38	200	1·270	6·800	2·032	8·460	·187	·240	·779	7·630	·0509	1·652	·0186	·920	·0126
G1	78B	3·93	220	3	200	3·007	12·20	3·652	13·99	·246	·261	·943	13·10	·0547	3·331	·0188	·999	·00704
G2	78B	4·57	230	5	200	2·624	11·87	3·178	13·73	·221	·232	·953	12·78	·0561	2·902	·0160	1·037	·00731
G3	78B	4·57	216	3	200	2·694	11·83	3·243	13·72	·228	·236	·966	12·78	·0562	2·970	·0162	1·062	·00745
G4	78B	4·57	325	1	200	2·679	12·19	3·238	13·93	·220	·232	·948	13·08	·0523	2·959	·0135	1·034	·00626
H1	224B	2·58	396	7	400	2·757	5·917	3·548	7·659	·466	·463	1·006	6·788	·0370	3·147	·0167	1·196	·00911
H2	227B	3·20	346	16	367	1·950	5·765	2·696	7·224	·338	·373	·906	6·495	·0322	2·323	·0175	1·145	·0104
X1	225B	3·20	869	36	920	2·012	5·764	2·730	7·529	·349	·363	·961	6·646	·0249	2·371	·0106	1·142	·00627
X2	220B	2·58	856	12	918	2·639	5·866	3·541	7·623	·450	·465	·968	6·743	·0246	3·089	·0132	1·182	·0066 2

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arbitrary nature. Before even experiment can be correlated with experience, however, it is necessary to be able to interpret experimental results in a rational and simple manner, and it was for this purpose that the present work was undertaken.

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52—THREAD TAKE-UP IN THE SEAMING OF KNITTED FABRICS

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Exact measurements have been taken, for a typical range of stitches made under working conditions, of the amount of thread, exclusive of waste, used in the seaming of knitted fabrics. A given length of seaming was unravelled and the sewing material measured directly. An alternative method of marking the yarn prior to seaming, and then noting the amount used in work, was found to be impracticable. By comparing the length of material seamed with the amount of yarn used to produce this length, what is termed the take-up is obtained, this being the number of unit lengths of yarn required to produce a unit length of stitching. With a yard unit, a take-up of 2 denotes that 2 yards of thread are required to produce 1 yard of seamed material.

Chain Stitch

The chain stitch, shown at Fig. 1, is produced from a single thread, and has great elasticity. It is employed as a sewing and linking stitch, and is also used extensively for felling over-edge seaming. The ornamental appearance of the reverse side of this class of stitch, as at B, Fig. 1, allows effective utilisation as an embroidery agent; the right side at A is quite plain. A variation of the chain stitch is termed the over-edge, as the loop is brought round the edge of the fabric in working. Another variation is the double chain stitch which employs two threads, and imparts similar elasticity with great security. From the following results it will be seen that (1) the take-up decreases as the tension number (as indicated on the machine) increases, the stitches per inch remaining constant, and (2) the take-up increases as the stitches per inch increase, the tension remaining constant.

Table of Normal Take-up

Stitches	7	8	9	10	12	14	16	19	22
Tension	7	7	9	9	12	12	16	16	22
Take-up	3·29	3·46	3·38	3·54	3·54	3·75	3·63	3·79	3·69

The Lockstitch

This stitch, illustrated in diagram at Fig. 2, is not elastic but secure, and principally used for attaching bands, linings, beige, and other rigid materials to knitted fabrics. Two threads are employed, a needle thread shown at A in Fig. 2, and a shuttle thread, as at B; both are usually of 3/60's sewing cotton counts. The following results indicate that the total take-up increases with the stitches per inch, for fabrics of the same thickness.

Type M/c	Stitches per inch	Take-up: Needle	Take-up: Shuttle	Take-up: Total
A	7	1·13	1·05	2·18
A	14	1·15	1·13	2·28
A	24	1·15	1·30	2·45
B	9	1·13	1·15	2·28
C	11	1·30	1·09	2·39
D (zig-zag)	18	2·00	2·55	4·55

Two Thread Overlock

This seam is shown enlarged at Fig. 3, where the needle thread and looper thread are interlaced. The seam is employed in the cut-up or circular trade for assembling the component parts of a garment. The stitch used is the two thread over-edge seam; a needle and a looper being employed for its formation. A modification of this method of seaming is applied to the welting of underwear and seamless hose, the same stitch being employed but with a narrower non-adjustable bight. The term bight refers to the distance from the edge at which the needle penetrates. Another modification is found in the ornamental clocking of hose and half-hose. The following results for this type are for the "ladder" or "reverse" stitch. The ornamentation is obtained by using in the needle a coloured yarn of lustrous material, often a two-fold mercerised cotton yarn. The looper thread is of fine counts of the same colour as the hose.

Type	Bight		Stitches per inch	Take-up: Needle	Take-up: Looper	Take-up: Total
Seamer A	Narrow	$\frac{1}{10}$ in.	20	8·4	6·02	14·42
	Intermed.	$\frac{1}{8}$ in.	20	9·0	7·6	16·6
	Wide	$\frac{3}{20}$ in.	20	10·25	7·9	18·17
Welter A	Fixed	$\frac{1}{10}$ in.	20	7·04	5·72	12·76
,, B	Fixed	$\frac{1}{16}$ in.	20	8·20	4·25	12·45
Clocking—	(Width of stem)					
(1) Spot		$\frac{1}{16}$ in.	14	4·9	4·6	9·5
(2) Close range		$\frac{1}{10}$ in.	28	8·25	10·1	18·35

Three Thread Overlock

A representation of this stitch is given at Fig. 4, and consists of a needle thread marked A, and two looper threads B and C. The seam is firmer than the two thread overlock, and is used chiefly for outer garments. The third thread is advantageous, inasmuch as the needle thread stitches inside the seam can be tightened, and thus rendered less liable to show through after scouring and subsequent operations. It will be seen from the following results, that although one extra thread is used, the total take-up in these tests is not greater than the two thread overlock seam. The seam under test was made using a bight or throw of $\frac{1}{10}$ in., and 15 stitches per inch, and the average of several such experiments shows the take-up to be as follows—Back looper 4·8, front looper 3·7, needle 1·8, total take-up 10·3.

Cup Seaming

This method of interlacing in this machine is the same as at Fig. 3, a needle thread and a looper thread being employed. This system is largely used for seaming all classes of selvaged goods. Although the corresponding loops of the two selvages are not joined together individually as in the point-to-point seam, the cup seamer is largely used for joining selvaged goods because of its quicker production. The seam produced is superior to the overlocking method, but is not as good as point seaming, and it thus occupies an intermediate position between the two methods. Coarse or fine gauge fabric can be seamed in this manner, the rule being that the needle pierces the fabric several times in excess of the number of courses per inch of the material being seamed. The result of several tests on this seam gives an average take-up of 5·0 for the needle thread, and 5·28 for the looper thread, making a total of 10·28. This is taken on a test piece with 14 stitches per inch.

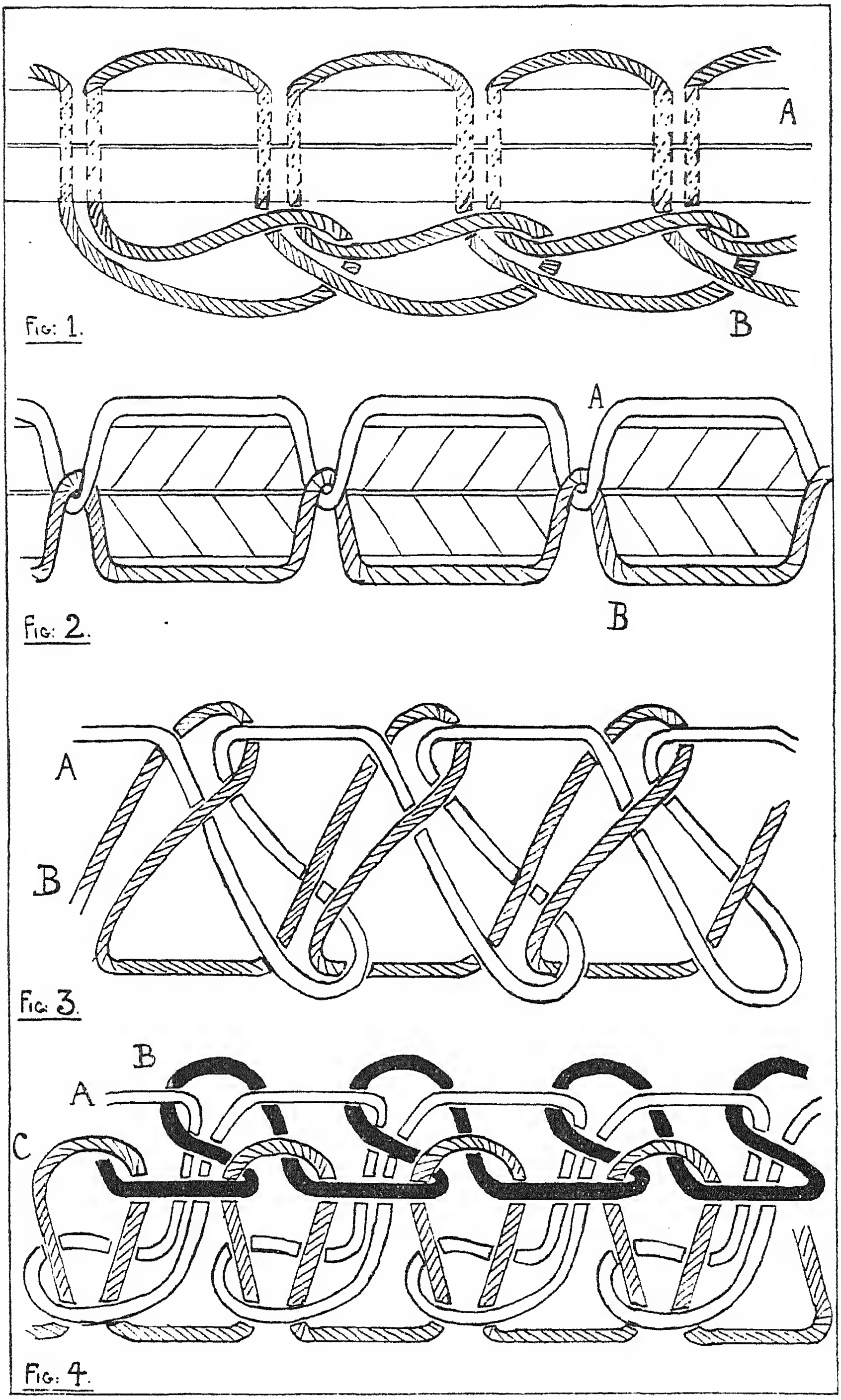

FIG. 1. Chain Stitch.
FIG. 2. Lock Stitch.
FIG. 3. Two-thread Overlock.
FIG. 4. Three-thread Overlock.

Double Chain Stitch

This method of seaming is largely employed in the industry for cut goods. Two threads are utilised, one in the needle and the other in the looper. It combines the advantages of the chain stitch (Fig. 1) and lock stitch (Fig. 2), being more elastic than the latter, and firmer than the chain stitch. A test sample with 10 stitches per inch was found to give a take-up of 1.18 for the needle thread, and a looper thread take-up of 3.75, making a total of 4.93. A modification of this system of interlacing is employed in the "twin needle double chain stitch," in which two needles share the under-looper thread, producing a cross interlooping on the under side of the fabric. This particular type of sewing is used in the hemming of hosiery garments, and in performing this operation the left hand needle pierces three thicknesses of fabric, whilst the other needle sews two thicknesses. This feature is well marked in the following take-up result, where the width of the seam under test was $\frac{1}{5}$ in., and 11 stitches per inch were made.

	Take-up	
Needle, left hand	3·3	(3 fabric thicknesses)
Needle, right hand...	2·1	(2 ,, ,,)
Looper	7·7	
Total take-up	13·1	

Still further use is made of the double chain stitch, in the "two line" modification, which employs two sets of members, each for producing a double chain stitch. A covering thread manipulated by a spreader is also introduced into the interlooping, in the form of a figure of 8. Soft-twisted mercerised cotton, varying in count from 2/16s to 2/12s, is used for the covering embroidery thread, and 3/60s sewing cotton generally used in the other four members. A flat seam is thus produced which, being ornamental yet neat, is used with effect for the necking of underwear. If for lace attaching, artificial silk is used as the embroidery yarn. A test sample of necking with 16 stitches per inch and a throw of $\frac{1}{5}$ in. gave the following results of thread consumption—

	Take-up		Take-up
Needle	3·25	Needle	3·20
Looper	2·40	Looper	2·40
		Covering thread... ...	4·40
Total take-up ...	15·65		

Triple Interlock Stitch

In this stitch there are five threads, comprising three needle threads, one in the looper, and an auxiliary thread. The latter is carried in front of the needles, and interlocked on the upper surface of the fabric, by combined movement of a carrier and spreader. The seam is flat and does not give discomfort in wear, and is further very ornamental in appearance. It is made use of in attaching lace, when the auxiliary thread produces a pleasing appearance if lustrous materials such as artificial silk are used. It is also a medium for attaching ribs to underwear on account of its elasticity. The following results were obtained from a stitch used for lace attaching, the width of seam being $\frac{1}{5}$ in. with 10 stitches per inch.

	Take-up		Take-up
Lower looper	8·25	Needle (1). ...	3·52
Upper looper (auxiliary) ...	4·96	,, (2) ...	2·64
		,, (3) ...	2·77
Total take-up ...	22·14		

Double Interlock Stitch

This variety is similar to the triple interlock, but one less needle is employed. The stitch thus consists of four threads, two needle threads, one looper thread, and one auxiliary which spreads itself over the seam. The stitch is flat, and is extensively employed in attaching lace to knitted underwear. The results given below are for lace attaching with 10·5 stitches per inch, and a width of seam $\frac{3}{16}$ in., the needles being a distance of $\frac{1}{8}$ in. apart. The covering thread for this experiment was of 420 denier artificial silk, 3/60's sewing cotton passing through other members.

	Take-up		Take-up
Looper	7·75	Needle (right)	2·29
Auxiliary covering looper	3·96	Needle (left)	2·67

Total take-up ... 16·67

Flatlock

This variety of seaming is extensively used for assembling garments cut from web. The edges touch each other, or abut and a very flat seam is thus produced. Nine threads are used, four in the needles, four looper threads, and one for a covering thread, and they are intersected to give what is virtually a new texture, uniting the two edges with double strength along the weakest point. As example of the yarns used the needles have 3/60's sewing cotton, the loopers 28's single cotton with 16's soft twist cotton or wool as the covering thread.

	Take-up 18 Stitches per inch	Take-up 20 Stitches per inch
Covering thread	10·1	10·5
Four needles (a) Outer	4·05	4·67
(b) Inner	3·75	3·8
(c) Inner	4·05	4·34
(d) Outer	3·0	3·2
Four loopers (a) Outer	5·1	7·2
(b) Inner	6·0	6·0
(c) Inner	5·9	6·0
(d) Outer	6·7	7·2
Total take-up	48·65	52·91

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53—THE ACTION OF AMMONIA ON WOOL

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SUMMARY

The paper describes some results of the action of aqueous and alcoholic ammonia on wool under various conditions of temperature, time, and concentration. A new method for the estimation of the amount of sulphur on the woollen cloth is described. The amounts of sulphur removed by the continued action of saturated lime water are also estimated.

DESCRIPTION OF EXPERIMENTS

The wool chosen for the experiments was fine Botany worsted serge, and no special purification of this was attempted (beyond the usual scouring operation) as experiment showed that for the purpose of the investigation, this was satisfactory. Some preliminary trials showed that wool treated with ammonia (even somewhat dilute) at a temperature of 90° C. under pressure was more or less completely decomposed and compounds such as ammonium sulphide formed. Hence the experiments were conducted at temperatures of 70° C. and lower, with varying concentrations and with variations in time of treatment. Usually, the wool was treated in Carius tubes and the heating conducted in a water bath; with larger quantities of wool, soda water bottles were employed. After treatment for the required length of time, the tubes were allowed to cool, the wool well washed and the wash waters added to the ammoniacal liquor. The sulphur was then estimated in both wool (after drying) and in an aliquot portion of the liquor. The methods of estimation are given below.

Estimation of Sulphur in Wool

About 0·4 gm. of dry cloth was separated into warp and weft and cut up into as fine a condition as possible. The mass was then mixed with 20 gms. of pure sodium peroxide and placed in a bomb similar to that described for use in coal analysis (*J. Soc. Chem. Ind.*, 1921, **40**, T74). The bomb was heated by means of a Fletcher burner until the mixture exploded and heating was continued for a further five minutes. After cooling, the inner tube was taken out and placed in a large porcelain dish covered with a clock glass. Water was then added until the tube was immersed. When all action had ceased, the tube was taken out and the liquid neutralised with hydrochloric acid. The sulphur was precipitated as barium sulphate in the usual manner, after the removal of iron with ammonia.

Estimation of Sulphur in the Ammoniacal Liquor

The liquid was slowly dropped into bromine water made strongly acid with hydrochloric acid, having excess of bromine and acid present the whole time. When all the liquor had been added, the excess of bromine was boiled off, the liquid filtered, and the sulphur precipitated as barium sulphate.

SPECIFICATION OF RESULTS

The sulphur content of the original cloth (calculated on the dry weight at 100–105° C.) was 3·92%. Heating with ammonia of strength, 100 ccs. =

12% by weight of NH_4OH, in the proportion of 1 part wool to 5 parts liquor, for 5½ hours at 70° C., reduced the sulphur content to 2·81%. The wool, though becoming more yellow, was not appreciably tendered.

In further experiments, and heating for periods of 13 and 19 hours, the sulphur content fell to 2·44% and 2·22% respectively. The solutions in both cases smelt strongly of ammonium sulphide, and the wool was more tendered and harsh in feel.

Similarly, cloth was heated for successive periods of 6½, 6, and 6½ hours, washing after each period and using fresh ammonia (strength as above) each time. At the end of each period the sulphur content was 2·73%, 2·47%, and 2·10% respectively. The cloth was left white, thin, and tender, and the final liquid possessed only a very pale yellow colour, having only a slight smell of ammonium sulphide.

Some further trials, carried out at lower temperatures, chiefly at 50° C., gave very similar results, except that less sulphur was removed for a similar length of time of heating. On heating for prolonged periods, especially those carried out with repeated treatments, the wool became tender. Some results are tabulated below—

Time of Heating	Temperature	Strength of Ammonia	Sulphur left in Cloth (dry weight)
6 hours	50° C.	100 ccs. = 12% by weight of NH_4OH	3·21%
18 ,,	,,	,, ,, ,,	3·16%
40 ,,	,,	,, ,, ,,	2·64%

Wool subjected to successive treatments with ammonia for four periods of 24 hours each, using fresh ammonia after each treatment, gave the following results—

	Temp.	Strength of Ammonia	Sulphur left in Cloth (dry weight)
After 1st 24 hours	50° C.	100 ccs. = 12% by weight NH_4OH	3·14%
,, 2nd 24 hours	,,	,, ,, ,,	2·48%
,, 3rd 24 hours	,,	,, ,, ,,	2·32%
,, 4th 24 hours	,,	,, ,, ,,	2·10%

In another experiment, using ammonia of the former strength, and with repeated treatments of 24 hours' duration, the wool was washed with dilute hydrochloric acid between each treatment and then with water. Results obtained were as follows—

	Temp.	Strength of Ammonia	Sulphur left in Cloth (dry weight)
After 1st 24 hours	50° C.	100 ccs. = 12% by weight NH_4OH	3·02%
,, 2nd 24 hours	,,	,, ,, ,,	2·80%
,, 3rd 24 hours	,,	,, ,, ,,	2·58%
,, 4th 24 hours	,,	,, ,, ,,	2·36%

Using ammonia double the strength of that used in the last experiment, but not washing with acid between successive treatments, the following results were obtained—

	Temp.	Strength of Ammonia	Sulphur left in Cloth (dry weight)
After 1st 24 hours	50° C.	100 ccs. = 24% by weight NH_4OH	2·96%
,, 2nd 24 hours	,,	,, ,, ,,	2·42%
,, 3rd 24 hours	,,	,, ,, ,,	2·11%
,, 4th 24 hours	,,	,, ,, ,,	2·01%

It was calculated that in the last experiment the wool substance dissolved amounted to 14%.

USE OF ALCOHOLIC AMMONIA

By the employment of alcoholic ammonia (absolute alcohol saturated with dry ammonia gas), it was found that a higher temperature could be employed without decomposition of the wool. Treatment at 100° C. for $5\frac{1}{2}$ hours reduced the sulphur content only to 3·65%, the wool becoming slightly more yellow, the liquid remaining clear and colourless, and smelling faintly of sulphur compounds. At higher temperatures, the wool became brown and tender.

STEEPING IN SATURATED LIME WATER

According to Chevreul, steeping in lime water reduces the content of sulphur in wool to 0·46%. In the experiment here carried out, no such great loss occurred. Wool was steeped for 21 days in saturated lime water, using fresh liquor every day and washing the wool with dilute hydrochloric acid and finally with water after each steeping. The sulphur content was found to be as below—

After 24 hours	3·65%
,, 48 hours	3·52%
,, 72 hours	3·42%
,, 7 days	3·32%
,, 14 days	3·32%
,, 21 days	3·32%

54—THE BREAKING OF YARNS AND SINGLE COTTON HAIRS

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INTRODUCTION AND SUMMARY

Although several methods are available for obtaining the tensile strength both of yarns and of single cotton hairs, little work has been done on the relation between the strength of a yarn and that of the hairs from which it was spun. In both cases the quantity usually measured is the breaking load or strain, but the relation between the two quantities need not necessarily be simple, complicated as it is by factors pertaining to yarn structure, e.g., counts and twist.

The opinion is widely held and frequently quoted in the literature[1,2,6] that the breaking strain of a yarn is only about 20% of that calculated from the individual fibres. Balls[1], for example, stated that "yarn does not break primarily through rupture of the hairs but by slip of hair on hair."

The evidence for such an opinion is difficult to discover and is probably not entirely experimental.* The first published work bearing on this relation is apparently that of Monie[6] and Bowman,[2] and the former emphasises that the results of his tests of different varieties of cotton were so erratic that a fixed table of average breaking loads would be misleading. This experience can readily be confirmed by any worker on the breaking load of single cotton hairs.

Monie asserted[6a] that "under ordinary conditions of manufacture only slightly over 20% of the strength (of the hairs in the yarn) can be utilised . . . . and where the material has been operated on by imperfectly worked machinery, or where the productive capacity of the various machines has been taxed beyond a proper limit, then only about 15% or 16% of the fibre strength is left available for the constitution of the yarn." The former assertion was supported by data from nine different yarns for each of which the actual lea strength in pounds was compared with the strength calculated from the average number of fibres in the cross section of the yarn multiplied by the mean test strength of each fibre. By this means he found that the average percentage of the strength of the fibre entering into the composition of the yarn was—American 23·3%, Egyptian 23·1%, and Brown Egyptian 22·3%. Very similar conclusions were reached by Bowman by methods which, presumably, resembled those employed by Monie.

Apparently, then, these figures form the principal data upon which the opinion is based that yarn does not break by rupture of the constituent hairs, but chiefly by slip of hair on hair.

This conclusion was accorded general acceptance and was not subjected to further examination until Turner,[8] in an analysis of the relation of yarn strength to single hair strength, based on data obtained by Balls, was able

*Recently, Balls has stated (*Empire Cotton Jr. Rev.*, 1925, **2**, 115) that this was not an original opinion and that most of the information on which it was based was merely tentative and unreliable.

to formulate a list of the factors which might account for the dissipation of the strength obtainable from the hairs. He formed the opinion, however, that the small proportion of the strength realised, in hard-twisted yarns at least, was certainly not due to slipping.

The earlier opinion, which is commonly held, appears all the more surprising when it is remembered that no direct method has hitherto been described by which the statement could be checked—that is, no method has been available by which the broken end of a yarn could be examined in order to determine the number of broken ends of single hairs actually occurring there, and the number of hairs which naturally ended there before the yarn was broken. The latter may be either tips, basal ends, or actual breaks produced during the spinning or preparation processes.

Projecting beyond both the broken and naturally ending hairs are those which have been pulled out, but these can easily be counted under a low power of the microscope (Plate I., A). These also may be tips, basal ends, or actual breaks, so that it is necessary to be able to distinguish all these. Actual observation gives the impression that by far the larger number of tips are lost during spinning and preparation, so infrequent is their occurrence.

The above difficulties of observation have now been removed by the introduction of the Congo Red staining method which has been described fully elsewhere.[3] By means of this it is possible easily to distinguish—

(1) The broken end of a hair (Plate II., A).
(2) The basal end of the hair where it was torn from the seed by the gin (Plate II., C).
(3) The cut end of a hair (Plate II., D).
(4) The tip of a hair (Plate II., B).
(5) The number of hairs ending naturally in a given fraction of the yarn length.

A highly magnified view of a portion of the end of a Sakel yarn, broken on the ballistic tester, is shown in Plate I., A, and of a cut end of the same yarn in Plate I., B. The hairs have been displaced to some extent during the staining process, but the characteristic mushroom ends of the cut hairs are well shown and can readily be distinguished from the broken ends of Plate I., A and C.

By the Congo Red method, therefore, it is possible to determine—

(1) The number and character of all the hairs present at the point of breakage.
(2) The average number of hairs ending naturally in the portion of yarn in which the break takes place, and
(3) By a process of subtraction, the number of hairs which have actually been broken.

The average number of hairs in the cross section of the yarn can be determined by counting those at a cut end and the percentage of broken hairs then calculated from the last two quantities.

This technique has been applied to a number of yarns broken on a single-thread tester or a ballistic instrument, and conclusive evidence has been obtained that yarn does not usually break by slipping of the individual hairs. In reality, a considerable proportion of the hairs are actually broken—as many as 70% in a Sakel 36's weft. Nor is there any definite relation between the breaking load of a raw cotton and that of the yarn itself.

This may be ascribed in a large measure to the indefiniteness of the quantity determined as the single hair breaking load, and the effects are examined of two factors which contribute to this, namely, presence of abnormal hairs and length of test specimen.

It is also shown that there is no direct relation between the single hair breaking load and the wall thickness of the hairs. As the distribution of the latter is quite regular, the explanation is again probably to be sought in the indefiniteness of the value of the breaking load.

EXPERIMENTAL METHODS

A schematic diagram of one half of a yarn break is shown in Fig. 1 as it appears after treatment by the Congo Red method. The circle indicates a field of the microscope which is 1·86 mm. in diameter when a $\frac{2}{3}$ inch objective is used in conjunction with a No. 8 eyepiece. In most cases some of the hairs lie outside such a circle, and it is necessary to examine a rectangle the width of which is that of a microscope field, i.e. 1·86 mm., as indicated in the diagram. A rectangle of this kind, e.g., ABCD of Fig. 1, is referred to in the text as a field.

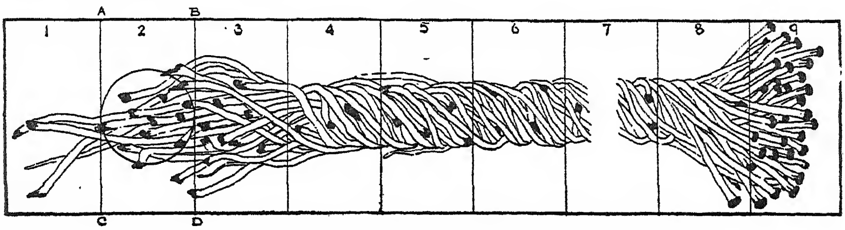

FIG. 1

The greater part of the break takes place in the first three of these fields, although the disturbance is carried to some extent into the next three or more, varying with the yarn under test. Consequently, after treatment with Congo Red, the number of visible hair ends in the first nine fields of a yarn break is made up as follows—

(1) First three fields—mainly ruptured hairs plus some of the ends which occurred here naturally before the break.

(2) Second three fields—a few ruptured hairs plus the number of ends occurring naturally before the break.

(3) Fields beyond the sixth—few or no ruptured hairs, generally only those occurring naturally.

In the case of the unbroken yarn, the number of ends occurring naturally in a field is, of course, approximately double that encountered in a field in the break itself. Proceeding down the yarn before this is broken, any end encountered may be the tip or base of a hair or a broken end. When the break occurs half of these are drawn to the other side of the break, the other half being retained.

A diagrammatic representation of a break is given in Fig. 2, the first three fields, naturally, fitting together originally.

To estimate the number of hairs actually broken, at least nine fields from the break are examined as follows—

(1) The number of ends in the first three fields is counted. This count includes the number of broken hairs plus half the number of ends occurring naturally.

(2) The number of ends in fields 4–6 is counted, giving the number of ends occurring naturally here plus one or two broken ones if the disturbance has travelled beyond the first three.

(3) The ends in fields 7–9 are counted, giving the number occurring naturally in three fields.

(4) From the sum of the first two counts $1\frac{1}{2}$ times the third is subtracted, the difference being the approximate number of ends actually broken.

(5) The yarn is cut across and the number of ends at the cut counted, giving the approximate number of ends in the cross section of the yarn. From 4 and 5 the percentage of hairs actually broken can be calculated, giving the minimum percentage taking part in the break and, therefore, contributing towards the strength of the yarn.

The above method of calculation involves the assumption that the broken end of the yarn originally overlapped the broken portion from which it was torn to the extent of three fields, i.e. the extreme end of the ninth field was originally 15 field-widths from the corresponding point on the other side of the break. If the overlap is greater or less than three fields there is an error in the estimation, but a calculation will show that the proportion of broken hairs is large enough for this to be safely neglected.

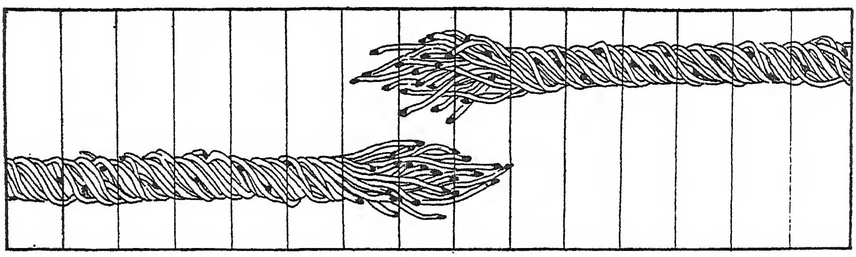

FIG. 2

DESCRIPTION OF TESTS

(1) A Sakel warp (36's, 20 turns per inch) was broken on both ballistic and single-thread testers to ascertain any influence of the type of breaking machine upon the character of the break.

(2) Samples of both weft and twist of the same counts (20's), and spun from the same cotton (Surat 1027 A.L.F.), were broken on the single-thread tester to investigate the influence of twist on the character of the break.

(3) Two yarns spun from Uganda Upland cottons, N.17 and A.2, both 64's twist with 29 turns per inch, were broken on the ballistic tester. The two raw cottons had the same staple length, but differed in breaking load and hair weight. It was desired to examine whether these differences influenced the character of the break.

Fifty observations were made in the Sakel tests and forty in the others.

The results are given in Tables I. and II., but the examples are too few and the degree of significance of the numerical results too low to permit of detailed comparisons being made. They are, however, sufficient to demonstrate that, in the majority of cases, yarn breakage does not take place by slipping but by actual rupture of more than half the hairs.

From the figures of Table I. the percentage actually broken was in each case calculated as shown in Table II.

Table I.

Cotton	Tester	Mean No. of Ends in 3 Fields each of 1·86 mm. width			Mean No. of Hairs in Cross Section
		Fields 1–3	Fields 4–6	Fields 7–9	
Sakel warp 36's ...	Ballistic	62	26	22	83
,, ,, ...	Single thread ...	66	25	21	84
Surat twist 20's ...	,, ,, ...	49	34	31	83
Surat weft 20's ...	,, ,, ...	39	34	27	78
N.17 twist 64's ...	Ballistic	38	22	20	46
A.2 twist 64's ...	,, ...	41	27	23	56

Table II.

Cotton	Tester	Total No. of Ends. Fields 1–6	No. of Natural Ends		No. of Broken Hairs	No. of Hairs in Section	% of Broken Hairs
			Fields 7–9	Fields 1–6			
Sakel warp 36's	Ballistic ...	88	22	33	55	83	66·5
,, ,,	Single thread	91	21	32	59	84	70
Surat twist 20's	,, ,,	83	31	46	37	83	44·5
Surat weft 20's	,, ,,	73	27	41	32	78	41
N.17 twist 64's	Ballistic ...	60	20	30	30	46	65
A.2 twist 64's	,, ...	68	23	35	33	56	59

Considering the tests individually, there was very little difference, in the case of the Sakel warp, between the effects of both testing machines. Again, there was no significant difference in character of break between the Surat twist and weft, but it should be mentioned that a separate test showed the number of turns per inch to be the same for both. The two Uganda cottons also showed little difference in character of break in spite of the differences in measurable characters. This was unexpected, for A.2 was the finer cotton with a greater number of hairs in the cross section of the yarn.

Additional data for the last two cottons are given in Table III. If these are treated by the method of Monie and Bowman, and the numbers in the second and final columns multiplied, it will be found that the actual single thread breaking load indicated is only 38% in the case of N.17 and 41% in that of A.2 of the value to be expected if each hair in the yarn cross section is assumed to have the mean single hair breaking load as determined by the O'Neill tester.

Table III.

Cotton	No. of Hairs in Cross Section	Hair Weight per cm.	Breaking Load	
			Single Thread	Single Hair
N.17	46	·00165 mg.	93·6 gr.	5·39 gr.
A.2	55	·00135 mg.	113·2 gr.	4·94 gr.

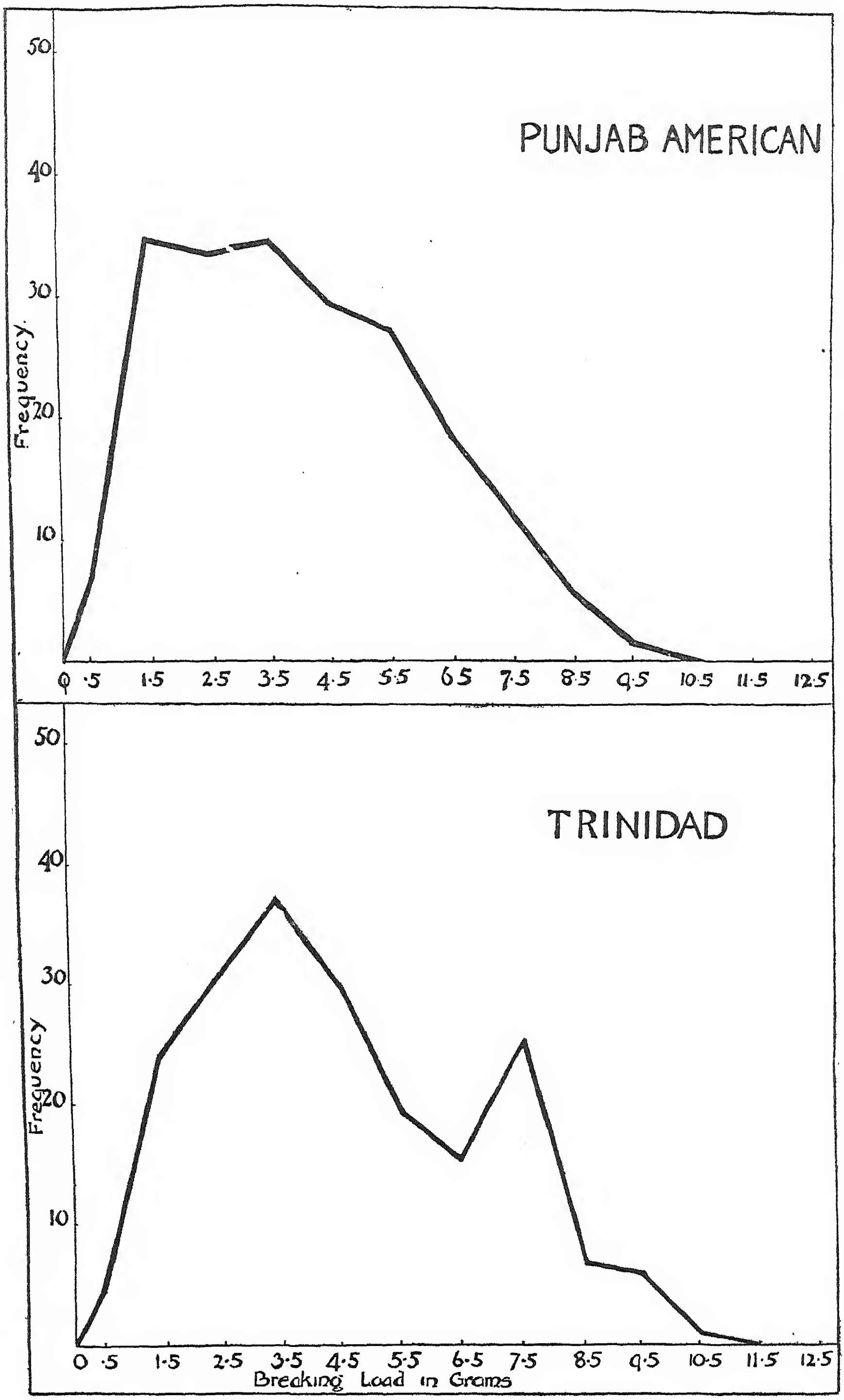
PUNJAB AMERICAN
Frequency.
50
40
30
20
10
0 ·5 1·5 2·5 3·5 4·5 5·5 6·5 7·5 8·5 9·5 10·5 11·5 12·5
TRINIDAD
Frequency
50
40
30
20
10
0 ·5 1·5 2·5 3·5 4·5 5·5 6·5 7·5 8·5 9·5 10·5 11·5 12·5
Breaking Load in Grams

FIG. 3

Such an assumption is unjustified on grounds of yarn structure alone, but, neglecting such considerations, it is still of interest to examine the possibility of the existence, on the basis of hair structure, of a direct relation between single hair breaking load and the strength of the corresponding yarn. Such a possibility appears remote when the figures of Table IV. are examined. Here the breaking load and lea strength are given for a number of Egyptian cottons and the yarns spun from them.

Table IV.

Cotton	Counts of Yarn	Breaking Load of Single Hairs (grs.)	Lea Strength (lb.)
Egyptian—			
Sakel 1	80's	5·67	31·8
,, 2	,,	4·16	30·4
,, 3	,,	5·18	33·9
,, 4	,,	4·49	30·9
,, 5	,,	4·73	34·7
,, 5a	,,	5·17	33·0
,, 6	,,	4·62	32·1
,, 310X	,,	4·90	33·5
,, X	,,	5·30	32·6
,, C/23	,,	5·25	32·8
Assili A/22	,,	5·70	24·8
Zagora	40's	5·01	34·3
,,	,,	6·45	35·6

No correlation is shown between yarn strength and single hair breaking load; on the contrary, the weakest yarn, Assili, has a high hair breaking load, while among the Sakels, although the weakest yarn (No. 3) has the lowest hair breaking load, the strongest yarn (No. 5) has the third lowest, and the greatest hair breaking load is possessed by the third weakest yarn (No. 1).

THE BREAKING LOAD OF SINGLE COTTON HAIRS

During an investigation of the measurable characters of typical cottons the single hair breaking loads of a large number of these have been determined by means of O'Neill's apparatus. In each case a random sample of 200 hairs was broken and the results classified in order to determine the mean value of the breaking load. It was generally found on plotting the frequency arrays that the curves were either two-peaked or decidedly skew, as shown in Fig. 3 by the curves for Trinidad and Punjab-American respectively. Increasing the number of observations did not modify the form of curve owing to the persistence in the sample of an undue proportion of weak hairs. Furthermore, the range was always extensive owing to the fact that some of the strongest hairs gave breaking loads twenty to thirty times as great as those of the weakest.

Data from which such curves are constructed do not lend themselves to elementary statistical treatment, nor has the arithmetic mean more than a slight significance from a practical point of view, as the data of Table III. confirm. It becomes of importance, therefore, to investigate the reason for this irregularity of the breaking load curve and its possible effect upon the quantity ordinarily determined as the breaking load.

If every hair were perfect the rupture of each would involve—

(1) The elastic properties of the cellulose and cuticle, presuming these are distinct.

(2) The dimensions of cross section of the hair.

Actually many hairs are imperfect and their rupture is decided by factors other than those included in the above. These may be (1) structural abnormalities which are either inherent weaknesses or are accompanied by points of weakness, or (2) points of weakness produced by mechanical action (e.g. cracks and bruises, caused by such processes as ginning and carding and which are purely local), or mildew action upon the cuticle and cellulose, which may either be local or distributed along the length of the hair.

Structural abnormalities of cotton hairs have frequently been described, for example by Denham,[5] who figured various types. It is generally accepted that these must constitute sources of serious weakness, but definite proof has not hitherto been forthcoming. The Congo Red method, however, permits of this deficiency being remedied, and the illustrations of hairs treated by this method, shown in Plate III., A, B, C, D, demonstrate clearly that abnormalities are usually accompanied by cracks or clefts which stain very deeply owing to the ability of the dye to penetrate into the body of the hair. Cracks of this kind are frequently encountered in hairs with no abnormality as shown in Plate III. C. It is clear that hairs of any of the types illustrated will break easily whether stretched longitudinally or subjected to lateral impact as in the carding engine or gin.

The most serious consideration, however, is that in the determination of breaking load by O'Neill's apparatus, no account can be taken of these abnormal or weakened hairs, nor are they likely to occur in the same proportions in different samples of the same cotton. Consequently the breaking load is likely to be affected to an unknown extent and, when determined on one sample, cannot be taken as a reliable index to the strength of either cotton or yarn. Even for the latter purpose a large number of separate determinations would be essential to compensate for this erratic distribution of abnormal and weakened hairs if a reliable numerical index were required.

Modification of Breaking Load by Abnormal Hairs

An attempt was made to determine the effect upon the breaking load of a sample of cotton of removing all hairs possessing obvious abnormalities. A random sample of 202 hairs of Zaria cotton was taken and the hairs examined separately under the microscope; 72 were found to possess abnormalities of structure. The hairs were then broken separately and the result expressed graphically as in Fig. 4, where the continuous line is the graph of the full sample, while the broken line represents the result after rejecting the abnormal hairs. It will be seen that the latter curve has become more regular owing mainly to the loss of hairs from amongst those with the lowest breaking loads, for few abnormalities occurred in the stronger hairs. The mean breaking load increased from 4·2 gr. to 5·1 gr. when the abnormal hairs were excluded, showing conclusively the importance of recognising their existence.

Even when they have been allowed for the curve is still far from regular, but it should be noted that many weak hairs, e.g., those with cracks or bruises, have not been taken into consideration. These smaller points of

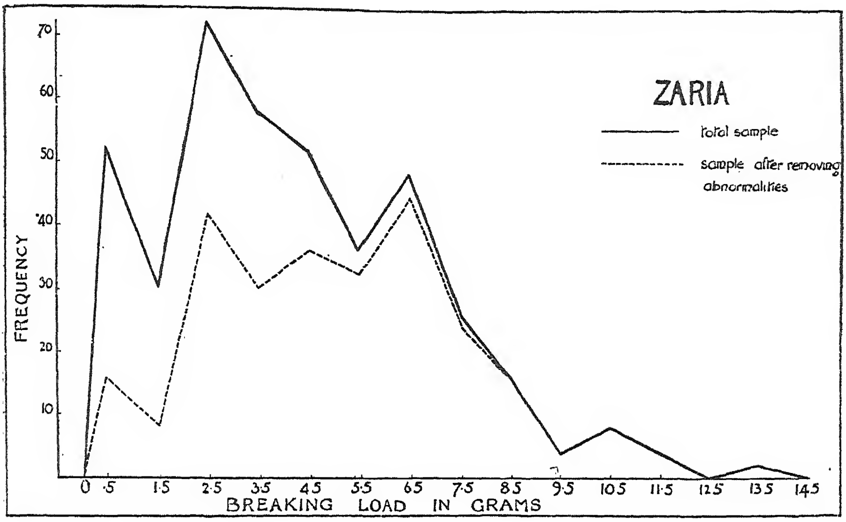

FIG. 4

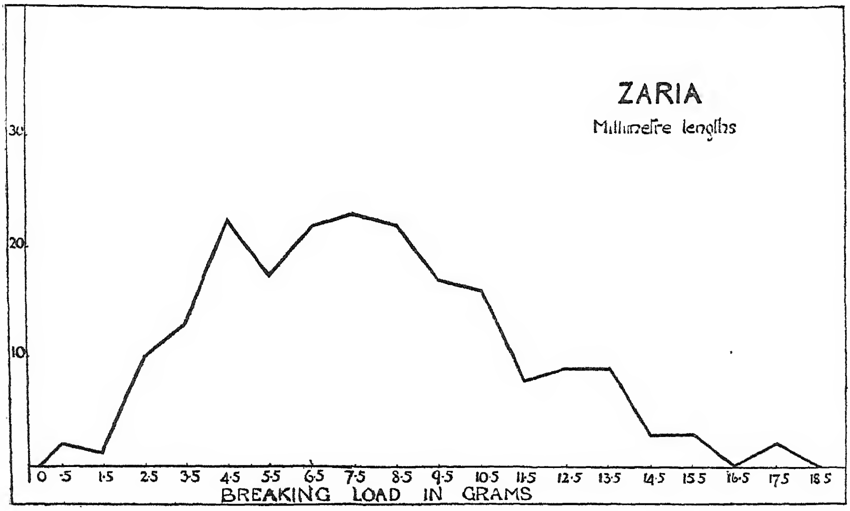

FIG. 5

weakness cannot be detected until after treatment by the Congo Red method, which is naturally inapplicable if the hairs are subsequently to be broken.

The Length of the Test Piece

A further consideration bearing on the regularity of the breaking load curve is the length of the portion tested. The test pieces employed by the majority of workers with the O'Neill method have generally been 10–15 mm. in length, that is, only about $\frac{1}{2}$ to $\frac{1}{3}$ of the hair length has been tested. The shorter the length tested the less chance there is of including the weakest point of the hair and the less irregular will be the resulting data. This was found to be the case when millimetre lengths of the Zaria cotton were

broken instead of the centimetre lengths previously employed. The breaking load curve in Fig. 5 shows that not only is the range greater, but that the mean (7·8 gr.) is much higher than was the case even when the abnormalities were subtracted from the centimetre lengths.

If whole hairs were broken instead of centimetre lengths, the character of the curve would again be different owing to the greater opportunity for weak places to be encountered. The best method, therefore, would appear to be to employ whole hairs in order to obtain the maximum chance of encountering the weakest place in each, rather than make this chance variable and intangible by employing an arbitrary fraction of the total length.

Relation between Breaking Load and Wall Thickness of Hair

In the absence of abnormalities it might be supposed that if the thickness of the cellulose wall of the hair varies from point to point along its length, and if variations of hair width are neglected, the hair will break at the point where the wall is thinnest. It was decided, therefore, to investigate the relation between breaking load and wall thickness. Five cottons were chosen and 24 hairs of each mounted for the O'Neill apparatus. Each centimetre length to be broken was then mapped under the microscope by means of the *camera lucida*, so that all its abnormalities, convolutions, and other distinctive features were registered. After being broken each was re-examined and the exact place of rupture noted on the map. The hair was then mounted horizontally, and the wall thickness measured both at this point and also at intervals along the full length. Note was made of the breaking load, the nature of the point of fracture, and the wall thickness at this point.

From the figures of Table V. it will be noticed that the rupture of most of the hairs can be accounted for, but a small residual number broke in a position for which no explanation could be advanced as a result of the preliminary microscopical examination.

Table V.

Cotton	Bengal	Durango (Annual)	Durango (Ratooned)	Sea Island	Zaria
No. of hairs	24	24	24	24	104
No. broken at thinnest part of wall ...	13	10	12	18	69
No. broken at an abnormality ...	8	13	7	5	31
Residual hairs ...	3	1	5	1	4

When the breaking load values were plotted against wall thickness at the point of rupture it was found that, if abnormal hairs were rejected, there were indications of a linear relation between the two quantities, as shown by the graphs of Fig. 6 for Sea Island and annual Durango. The ratooned Durango was exceptional; no such relation was evident, which suggests that, in addition to the abnormalities of hair weight and wall thickness described previously for this cotton,[7] there are possible abnormalities in the composition of the wall of the hair.

It seemed desirable, therefore, to investigate more closely the relation between wall thickness and breaking load in a number of different cottons.

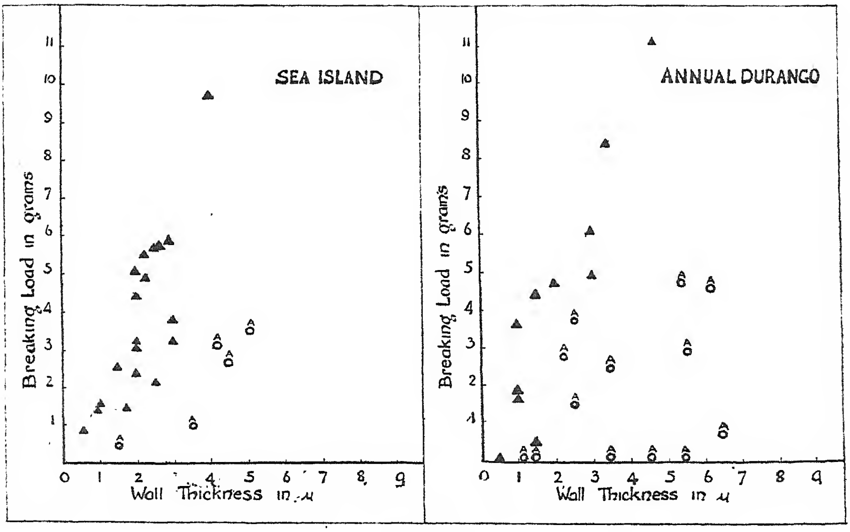

FIG. 6

For this purpose 14 cottons were selected and sampled. To determine the wall thickness, sections were cut by the gelatin method[4] and 200 from each sample were drawn by means of the projection apparatus. The wall thickness was measured in the four positions where the major and minor axes crossed the section and the mean taken. This was found to give, within the limits of error, quite as satisfactory a value as the mean of a large number of measurements taken at intervals round the section. The measured values of wall thickness are subject to a correction for the linear increase which takes place during the section cutting process.[4] This is about 27% of the original thickness, but as it has not actually been determined for all these cottons the values are left uncorrected. The mean wall thickness for the variety was then calculated from the 200 observations. Finally, breaking loads were determined on separate but similar samples.

Table VI.

Cotton	Brkg. Load (gr.)	Wall thickness (μ)	Cotton	Brkg. Load (gr.)	Wall thickness (μ)
Durango (annual) ...	4·5	4·4	Sea Island	4·9	3·2
Durango (ratooned)	3·8	3·8	Zaria ...	5·7	4·3
Queensland ...	4·8	4·8	Khanewal 285 F.	3·1	3·0
Texas	6·2	5·0	Punjab-American	4·9	4·1
Bengal	7·1	7·7	,, ,,	6·8	4·5
Peruvian	8·3	6·1	,, ,,	5·6	5·9
Sakel	5·5	3·7	,, ,,	5·5	5·9

The results given in Table VI. and plotted in Fig. 7 show that the relation between the two quantities is not very definite. Cottons with approximately equal wall thickness may have very different breaking loads, and *vice versa.* Most of the disturbance of the relation is due to the irregularity and variability

of the quantity determined as breaking load, and the responsibility of the wall thickness is only a minor one, for its distribution throughout a sample of cotton is invariably regular, as the curves of Fig. 8 demonstrate. Some portion of the lack of relation is no doubt due to the fact that it is the wall

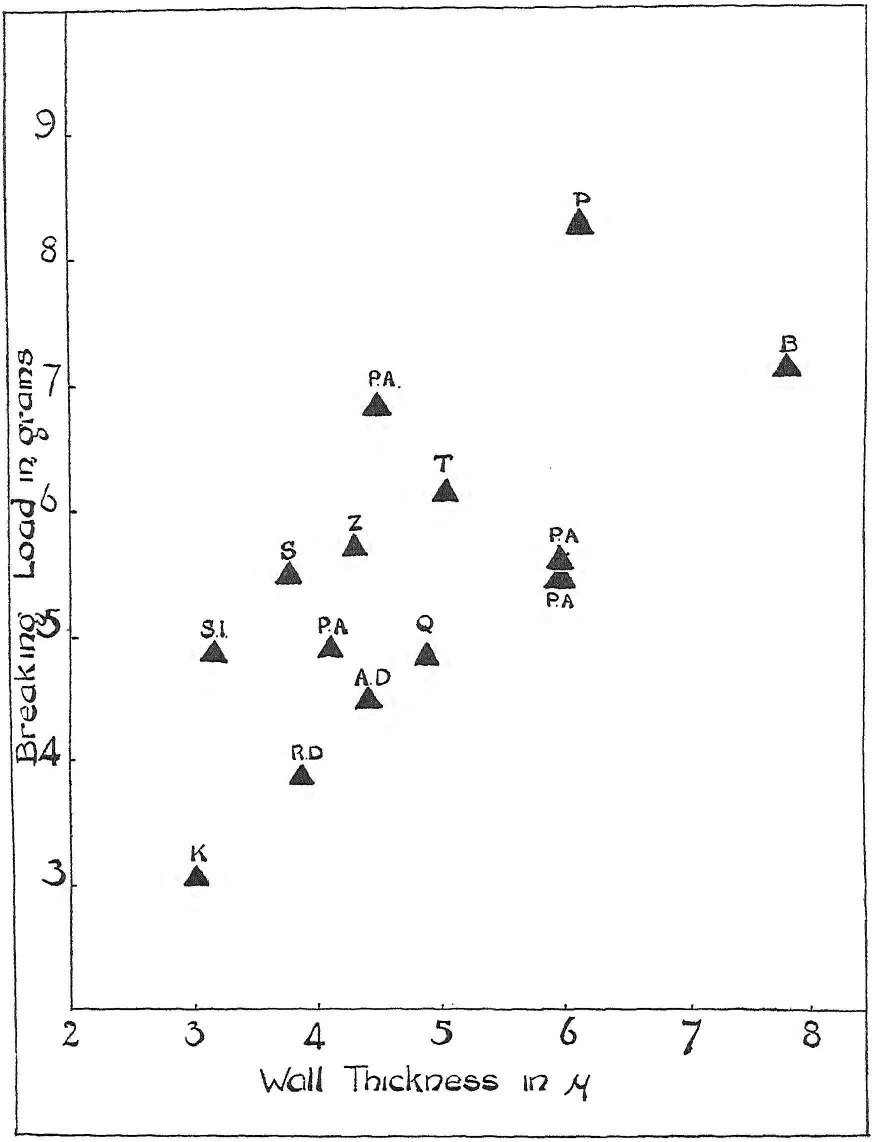

FIG. 7

thickness at the actual point of rupture which is important, so that the results should, probably, not be interpreted as showing more than that the finer cottons with thinner walls do not necessarily possess low breaking strains.

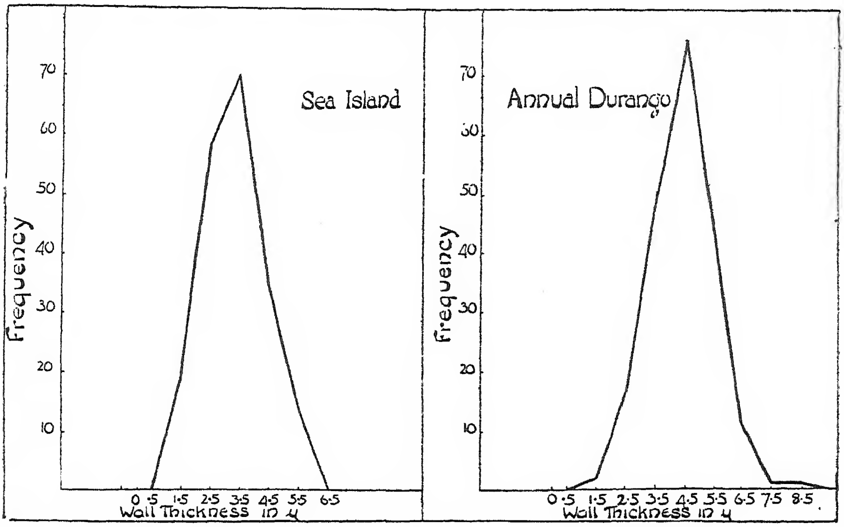

FIG. 8

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DESCRIPTION OF PLATES

PLATE I.—Broken and cut ends of Sakel yarn after treatment with Congo Red. Magnification 60.

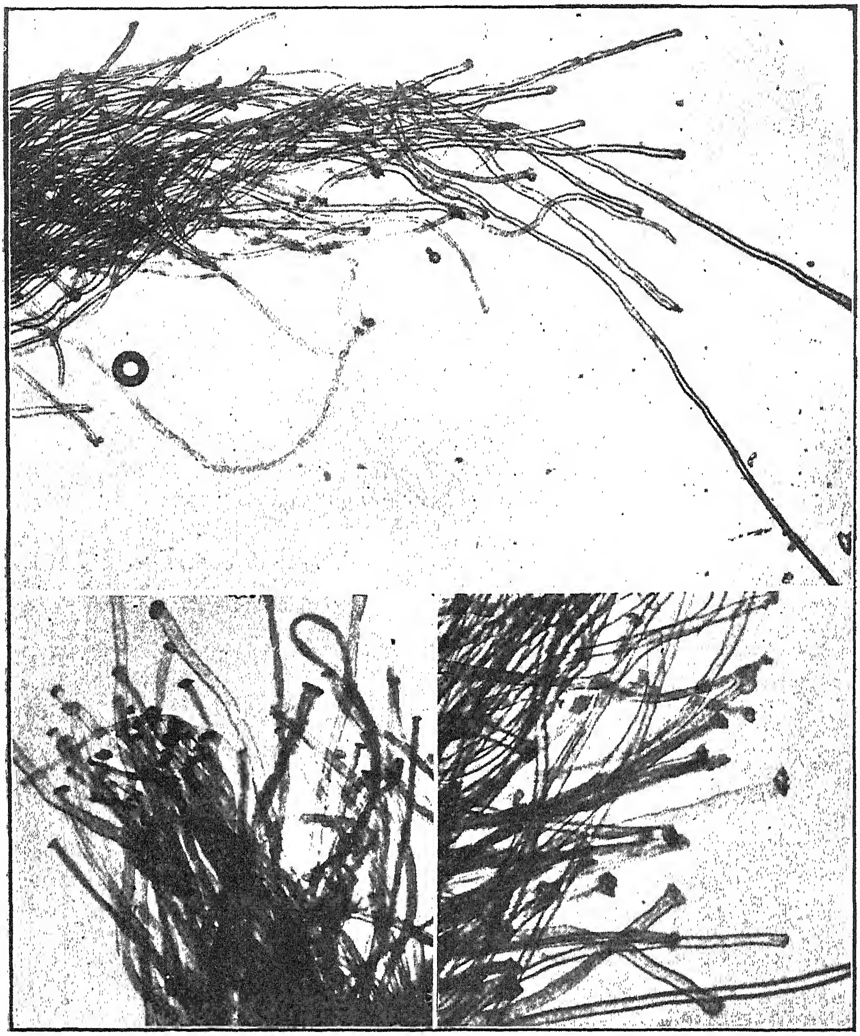
A and C ... ... Broken ends.
B ... ... Cut end.

PLATE II.—Broken and cut ends of Cotton Hairs after treatment with Congo Red. Magnification 500.

A ... ... Broken end.
B ... ... Tip of hair.
C ... ... Hair base.
D ... ... Cut end.

PLATE III.—Abnormalities of Cotton Hairs under treatment with Congo Red.

A—Broken end of Sakel Yarn. ×45.

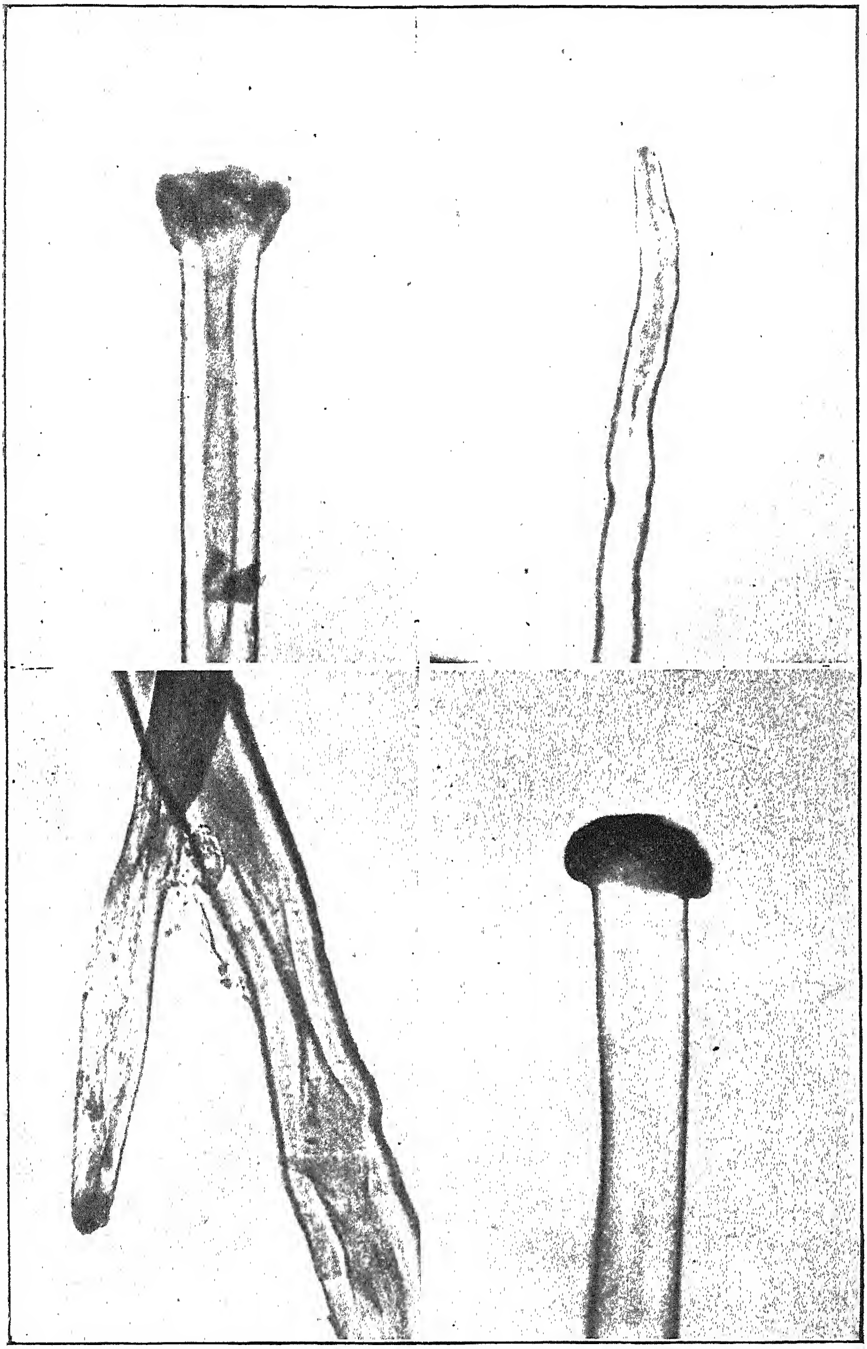


B—Cut end of Sakel Yarn. ×60. C—Broken end of Sakel Yarn. ×75.

PLATE I.

Yarn Ends after Congo Red treatment.

A—Broken end of hair. × 500. B—Tip of hair. × 500.

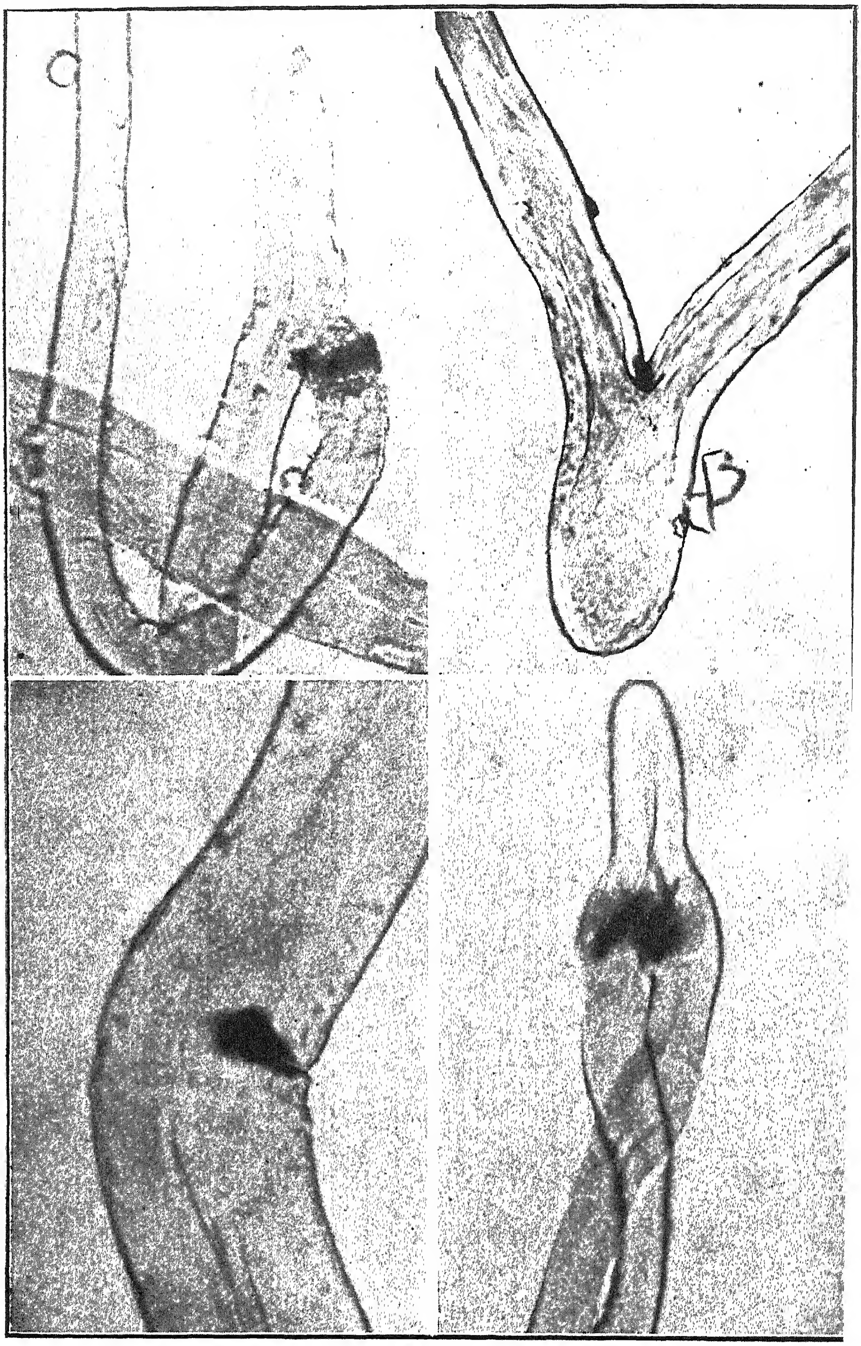


C—Base of hair. × 500. D—Cut end of hair. × 500.

PLATE II.

Sakel Cotton after Congo Red treatment.

A. ×450 B. ×450



C. ×900 D. ×450

PLATE III.

Abnormalities from Cambodia Cotton after Congo Red treatment.

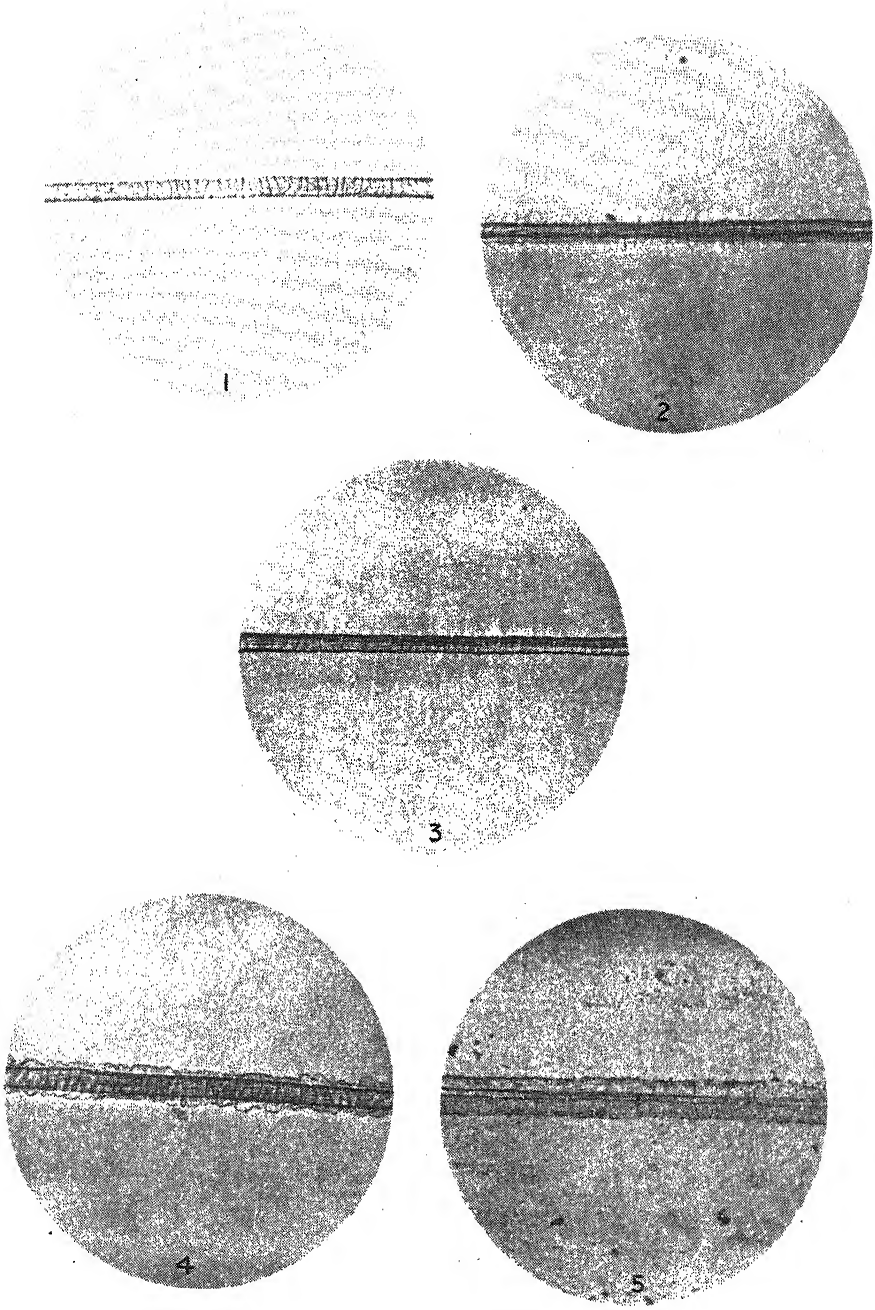


PLATE I.

face page 1007

55—THE CHLORINATION OF WOOL

By JOHN B. SPEAKMAN, M.Sc., and A. C. GOODINGS, M.Sc.
(Department of Textile Industries, The University, Leeds)

INTRODUCTION

During the past two years one of us has been engaged on a comprehensive study of the milling process of the wool textile trade. By way of the "elasticum reaction," discovered by Allworden[1] and investigated by Naumann,[2] we were led to study the chlorination of wool as a means of elucidating certain problems arising in the main investigation. It is felt that this explanation of our approach to the subject is in some measure due to Messrs. S. R. and E. R. Trotman and colleagues[3] who have, by a series of recent valuable papers on the chlorination of wool, made the subject almost their prerogative. Our own study of the same problem has, however, led to the discovery of a totally new aspect of the origin of damage to chlorinated wool and has thereby indicated what is undoubtedly the correct line of investigation along which improvements in the unshrinkable wool trade must be sought.

The cause of the unshrinkability of chlorinated wool appears never to have been satisfactorily established. The outer scales of the fibre, which are regarded as responsible for shrinkage, are variously stated[4] to be either fused down or, alternatively, eaten away by the action of chlorine. Examination of commercially chlorinated wool does not, however, give credence to either view, for the scales of the fibres are easily visible. (The sample examined was a Southdown wool sent for chlorination from this department.) Excess of chlorine will, of course, completely destroy the cuticular scales, but the amounts of chlorine used in practice to produce unshrinkability are small in comparison. Further, it appears to be unknown how far wool can be made unshrinkable by chlorination and no published information appears to exist relative to the amounts of chlorine necessary to obtain a required degree of unshrinkability with wools known to possess widely different milling (shrinking) properties.

These two features of the subject, the cause of unshrinkability and the amounts of chlorine necessary to produce this condition, form the subject of the present paper. The results of the major investigation on milling will be reserved to a later date.

PART I.—THE CAUSE OF UNSHRINKABILITY

A microscopic study was made of the actions of chlorine and hypochlorous acid on merino wool fibres and the results are typified by the set of five microphotographs reproduced. Trotman[3] has shown that the actions of chlorine and hypochlorous acid on wool appear to differ in many respects, although both reagents will produce the condition of unshrinkability. It becomes necessary therefore to study each reaction separately, and to comply with this condition the hypochlorous acid was prepared free from chlorine. Fibres taken from wool previously extracted with ether in a Soxhlet apparatus were mounted singly on glass slides by means of sealing-wax. The action of each reagent could be followed from the moment of

inception by applying a drop of the solution to the edge of the cover slip resting on the fibre. The slow diffusion of the liquid between the glass surfaces allowed the different stages of a series of rapid reactions to be studied with care.

The first photograph shows the type of fibre examined. When this is treated with chlorine water the blisters of the "elasticum reaction," shown in the second photograph, are obtained. Under the conditions of treatment employed, the growth of the blisters occupied a relatively long time, and it was observed that they began to grow at the free edges of the scales and continued *above* the surface of the scales next along the fibre. The membrane surrounding each blister is not therefore a distended scale as Allworden supposed, but presumably some protein decomposition product formed by the action of chlorine on the substance of the fibre. In the early stages of the reaction the number of blisters appeared to be equal to the number of scales, but as time went on coalescence occurred. The mode of fusion appeared to be exactly similar to the coalescence of oil droplets, and although the blisters possessed a certain amount of rigidity, the existence of a distinct and definite membrane is uncertain. The "elasticum reaction" can be observed with any concentration of chlorine, but the time necessary to form blisters of definite size increases rapidly as the strength of the solution decreases. Hypochlorous acid, on the other hand, does not show the reaction, as indicated by the absence of blisters in the third photograph. Here the edges of the scales appear to be even more distinct than in the case of the untreated fibre. The appearance of the second photograph is deceptive as regards scales, because focussing was made on the blisters. With both chlorine and hypochlorous acid, therefore, microscopic examination failed to reveal any drastic alteration of the fibre, and an *impasse* appeared to have been reached.

The chlorination of wool does not, however, end simply with the treatment of wool with chlorine or hypochlorous acid. The goods are afterwards dechlorinated and washed in soap or sodium carbonate solution or both. The profound changes initiated by the action of the latter reagents on chlorinated wool are shown in the fourth (chlorine) and fifth (hypochlorous acid) photographs. The actions of neutral soap and sodium carbonate are very similar, and the illustrations therefore refer to sodium carbonate only. (The spotted appearance of the fifth photograph is due to the carbon dioxide liberated by the neutralisation of uncombined hypochlorous acid.) From the moment of contact with the alkaline solution the outer layers of the fibre swell with great rapidity, until finally the whole fibre is surrounded by a sheath of jelly. In the fifth photograph a central core of unchanged wool can be clearly distinguished, and it is obviously possible by means of the test just described to determine the degree of penetration of the chlorinating agent into the wool. The smaller swelling obtained with chlorine is due simply to the use of a weaker reagent. With very small amounts of either chlorinating agent the swelling in soap or soda is too small to be distinguished, but there appears to be a tendency for a few of the scales to be detached bodily from the fibre without the intervention of mechanical action such as rubbing. This tendency is greater in the case of soap. Examination of swollen fibres showed that the scales lie on the outside of the jelly layer in a more or less undamaged condition, depending on the strength of reagent used. When the swollen fibres are washed free from alkali and

allowed to dry, they revert to their normal size and show definite scale markings. Re-immersion in water causes the reproduction of the swelling although perhaps to a smaller degree.

DISCUSSION OF PART I.

Conclusions of great importance can be drawn from the preceding observations. The fact that the scales lie on the outside of the jelly layer of swollen fibres, and that dry fibres after chlorination and swelling show definite scale markings, indicates that the scales are more resistant to the action of chlorine than the cortex. The layer of cortical cells within the cuticle is attacked by chlorine and the protein compound so much simplified by the consecutive actions of chlorine and soap or soda that under such treatment considerable swelling can occur. The enhanced swelling is in itself a proof of simplification of protein structure. The intervention of a layer of jelly between the scales and the unchanged core of the fibre is the cause of unshrinkability. Under mechanical action, as in a milling machine or during rubbing, the scales cannot cause the fibre-travel necessary for shrinkage because of their weak attachment to the body of the fibre. The probability is that the cuticle itself would suffer abrasion. High concentrations of chlorine, higher than are ever used in chlorination practice, undoubtedly cause gelatinisation of both cuticle and cortex, and the scales might in such cases be considered as fused down. Such conditions are never experienced except in over-chlorinated wool, and the former explanation of unshrinkability therefore remains valid.

Further, chlorine and hypochlorous acid should not by themselves be regarded as agents for the production of unshrinkable wool, since the action of soap or soda on chlorinated wool forms a vital part of the process. Although unshrinkable wool is not normally subjected to the action of acid, it should be noted that acids will produce the swelling necessary for unshrinkability, and in consequence chlorinated wool is unshrinkable to acid as well as soap milling.

The formation of a layer of jelly by the consecutive actions of chlorinating agents and soap on wool is responsible for the bad wearing properties of some chlorinated wools. Under mechanical action, this layer and the surrounding scales are easily worn away. The slimy feel of over-chlorinated wool is attributable to the same cause, the formation of a layer of jelly surrounding the fibres. The discovery of the cause of unshrinkability and of the defects usually associated with chlorinated wool is not merely of intrinsic value, for to discover the cause of defects is in this case to suggest a remedy. It is obvious that the faults of unshrinkable wool can be eliminated by any process capable of causing the jelly layer formed in soap or soda to shrink and harden to the unattacked core of the fibre, but in order concurrently to ensure unshrinkability it will be necessary to use sufficient chlorine to cause both scales and outer cortex to gelatinise. Such a process would possess great technical importance, and in consequence considerable time has been devoted to the search for a suitable condensing agent. The more obvious substances like formaldehyde, tannin, quinone, &c., were used without avail, but a solution of the problem was finally obtained by the use of certain mordanting agents. It was found that chlorinated wool, mordanted either before or after swelling in soap or soda, did not show the characteristic gelatinisation in these reagents, but in order to ensure unshrinkability, it is better to cause gelatinisation before mordanting unless

an excess of chlorine is used. The best results were obtained with chrome mordants, alum being of relatively little use.

The merits of the mordanting process were examined as follows. Three pieces of a good quality merino fabric of light weight were chlorinated with 4% chlorine (measured on the weight of wool), and after dechlorinating and washing in soda, two were mordanted with potassium dichromate and alum respectively, while the third remained unmordanted. All the pieces were milled together in the milling machine for 50 minutes to compare their unshrinkability and wearing properties. The chrome-mordanted piece was unshrinkable and unaffected in appearance by the drastic action of the milling process, whereas the piece mordanted with alum and the third unmordanted piece soon became thin and developed holes. It is obvious therefore that the correct remedy for the bad wearing properties of chlorinated wool is, as far as dyed goods are concerned, to be found in the use of chrome mordant dyes. The problem is more difficult in the case of undyed goods, and the search for a suitable hardening agent is being continued.

PART II—THE AMOUNT OF CHLORINE NECESSARY TO PRODUCE UNSHRINKABILITY

The following experiments were designed to measure the extent to which wool can be made unshrinkable and the amounts of chlorine required to produce unshrinkability with wools possessing widely different milling properties. It is essential clearly to distinguish two kinds of shrinkage—that due to the release of latent strains in the fabric on immersion in water, commonly called London shrinkage, and that brought about by mechanical action, called felting. The former can be prevented by the crabbing process and the latter by chlorination. In view of the dual nature of shrinkage, the action of chlorine in reducing felting can be satisfactorily studied only with cloths in which all latent strains have been released by immersion in water and subsequent drying under no tension. This criterion has been complied with throughout the present investigation.

Cloths constructed from Wensleydale, Oxford Down, and Southdown wools were used, details of the structure being the same in all cases and as follows—

Yarn—10's Yorkshire skein woollen, 5 turns per inch. Ends—24 per inch. Picks—24 per inch. Weave—2/2 twill.

The following is a broad outline of the experimental procedure. Yard lengths of cloth were cut from the pieces, and after trimming to a standard weight (270 grams air-dry), their areas were measured between guide lines sewn along the edges. One piece from each wool was kept untreated, and the remainder treated with varying amounts of chlorine in aqueous solution. After immersion in $N/10$ sodium carbonate solution all the yard lengths of cloth were washed in running water overnight and, after drying, sewn together for milling in the milling machine. The method of sewing was not indiscriminate, because it was feared that the close proximity of an unshrinkable piece to an untreated, for example, might cause mutual interference with shrinkage. The order of sewing was therefore arranged with regard both to the different milling properties of the wools and to the degree of chlorination of each sample. Milling was carried out with a soda-tallow soap and, after washing and drying, the several pieces were cut apart and their areas remeasured. Acid milling experiments were made with two of

the wools, Wensleydale and Southdown, the procedure being exactly as above except that the sodium carbonate treatment was omitted and milling was carried out with sulphuric acid instead of soap.

The method of chlorination requires more detailed explanation. In view of the great affinity of wool for chlorine, precautions must be taken to ensure even chlorination of all fibres, especially where yarn structures are concerned. It is also necessary, for reasons outlined in the first part of the paper, to confine the action of chlorine as far as possible to the outside of the fibres. After numerous trials, the method finally adopted to avoid these defects and to ensure reproducible results was as follows. Each yard length of cloth was immersed in two litres of water and allowed to soak overnight. The required amount of chlorine was used in solution in two litres of water, and was added to the water in which the cloth was immersed in small quantities at a time (about 0·1 gram for each addition), the cloth being kept in motion during addition and subsequent absorption of chlorine. Unabsorbed chlorine was finally estimated by titration of a sample of the residual liquor.

The experimental results are given in Tables I. and II., the amounts of chlorine being expressed as a percentage of the weight of wool (270 grams air-dry) and the milling shrinkage as the percentage reduction in area.

TABLE 1—SOAP MILLING

Kind of Wool	% Chlorine Used	% Shrinkage	% Chlorine Used	% Shrinkage
Wensleydale	Untreated	33·7	2·13	17·8
	0·39	33·9	2·24	18·4
	0·91	29·5	2·58	12·9
	1·50	22·5	3·07	12·0
	1·73	21·3	3·62	10·5
Oxford Down	Untreated	28·0	2·30	7·1
	0·44	26·8	2·42	6·3
	0·84	22·6	2·80	4·9
	1·02	18·8	3·40	1·2
	1·53	12·8	4·06	—2·5
	1·78	10·5		(Increase)
Southdown	Untreated	16·3	1·95	4·4
	0·38	15·6	2·39	2·9
	0·72	12·5	2·73	4·5
	1·07	9·8	3·40	1·3
	1·37	7·1	3·44	3·1
	1·90	5·2		

TABLE 2—ACID MILLING

Kind of Wool	% Chlorine Used	% Shrinkage	% Chlorine Used	% Shrinkage
Wensleydale	Untreated	34·4	2·10	18·3
	0·39	31·9	2·56	16·1
	0·78	25·8	2·90	15·5
	1·27	22·1	3·15	14·2
	1·77	18·4	3·32	14·1
Southdown	Untreated	16·7	1·85	5·9
	0·37	15·5	2·46	4·5
	0·93	10·8	2·69	3·1
	1·23	8·8	2·90	4·0
	1·51	6·8	3·30	2·4

Chlorination was not carried beyond 4% chlorine on the weight of wool, for, even with 3%, the wool was definitely over-chlorinated and had an unpleasant, slimy feel in water.

DISCUSSION OF PART II.

Discussion can best be effected by reference to the Figs. 1 and 2 for soap and acid milling respectively. The five shrinkage / per cent. chlorine curves are remarkably similar in type, and can in general be divided into three sections—

(1) *Inhibition Period.*—Small quantities of chlorine (0·3% on the weight of wool) produce little or no effect on the shrinkage properties of wool as shown by the first dotted portions of four of the five curves.

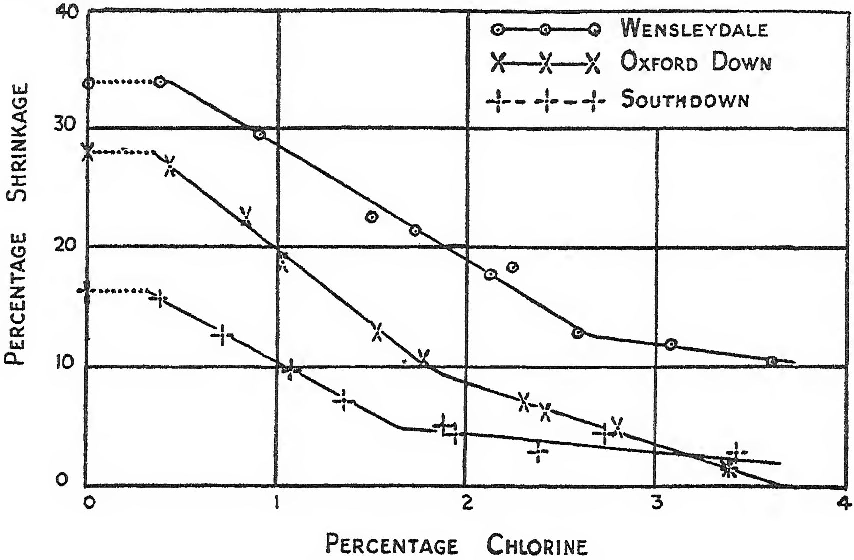


FIG. 1. SOAP MILLING

(2) *Period of Rapid Reduction of Shrinkage.*—Beyond the inhibition period, further additions of chlorine result in a rapid reduction of shrinkage. In this region the five curves run approximately parallel, indicating that equal additions of chlorine to the same weights of different wools will produce the same *absolute* reduction of shrinkage. This is a somewhat surprising result, although cursory examination of the problem would suggest that the better milling wools should require proportionately more chlorine than the worse milling ones to reduce shrinkage to a definite limit. The parallelism of the curves must, however, be accidental and illusory, as shown by the following considerations. Reduction of shrinkage is effected by the formation of a layer of jelly beneath the scales and the progressive reduction with increasing quantities of chlorine is due simply to the increasing number of fibres rendered ineffective. Fine wools should therefore require more chlorine than coarse to produce absolute unshrinkability on account of their greater surface area per unit weight, but as there is no semblance of correlation between fineness and milling properties, it is obvious that the shrinkage curves cannot run parallel. Unfortunately, this simple argument is invalidated by the absence of information relative to the amounts of chlorine required by different wools to produce a sufficient gelatinisation to prevent shrinkage, and by inadequate knowledge of the rates of diffusion of chlorine to the interior of yarns of the same counts, but composed of different wools. There is, however, ample justification for regarding the parallelism of the curves as accidental.

(3) *Period of Slow Reduction of Shrinkage.*—The preceding period of rapid reduction of shrinkage is followed by one of slow reduction, all the curves showing a well-defined point of inflexion. It has already been shown that the cortex of wool fibres is more readily attacked by chlorine than the cuticle, and it is more than probable that the inflexion points are determined by the preferential absorption of chlorine by the exposed cortex of fibres on the outside of the yarn. This would prevent the inner fibres from attaining unshrinkability. Evidence in favour of this view was obtained by

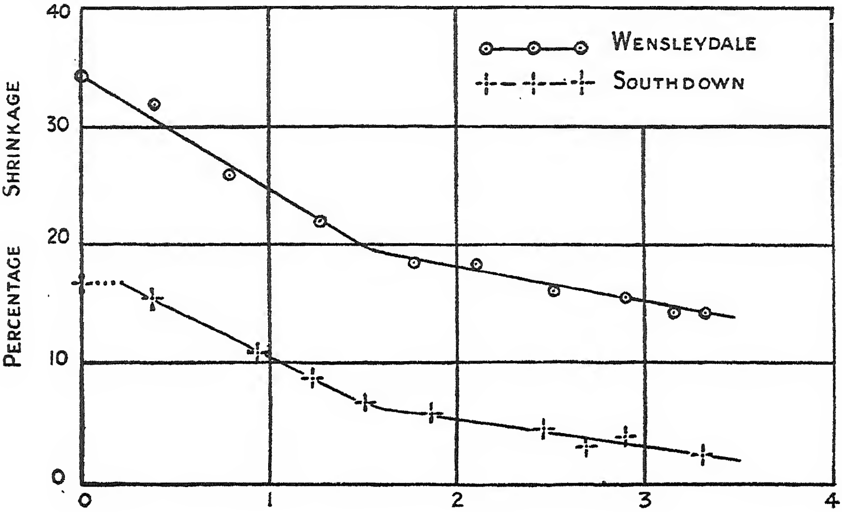


FIG. 2. ACID MILLING

examination of the yarn of chlorinated cloths by means of the swelling test described in Part I. The inner fibres of the yarn were found to be less chlorinated than the outer. The diffusion factor mentioned previously is therefore of vital importance, and is largely responsible for the difficulty in attaining absolute unshrinkability. In our experiments only the Oxford Down cloth reached this condition, and it is more than certain that the Wensleydale cloth would undergo complete destruction before becoming unshrinkable.

The amount of chlorine required by a particular material to produce a definite degree of unshrinkability is therefore a complex function of many variables—the kind of wool and its fineness, the yarn structure and the cloth structure. Hence, although experiments of the kind just described clearly demonstrate the possibility of producing absolute unshrinkability by chlorination, they nevertheless fail in their second object of determining the amounts of chlorine required by different wools to attain this condition. They do not even permit of the deduction that the better milling wools require more chlorine than the worse milling ones. It is probable, however, that determinations of the amounts of chlorine required by different wools in *loose* form to produce swelling of a definite order of magnitude in soap or soda, will provide the necessary data, and experiments on these lines have been commenced. The importance of the diffusion factor has been insufficiently appreciated, and from first principles it would appear that the

best results would be obtained in practice by chlorinating wool in loose form. How far this is a practical proposition can be determined only by further experiment.

GENERAL CONCLUSIONS

The reduction of shrinkage obtained by chlorination of wool is due to the formation of a layer of jelly between the unattacked cortex and the cuticle of wool by the consecutive actions of chlorine and soap or soda.

The bad wearing properties of unshrinkable wool are due to the ease with which the jelly layer and its surrounding scales are removable by friction.

A process, applicable only to dyed goods, has been devised for shrinking and hardening the jelly layer to the unattacked part of the cortex and thereby improving the wearing properties of the wool.

Absolute unshrinkability is attainable under particular conditions. The limiting factor in this respect is the difficulty of ensuring even chlorination of all fibres, especially where yarns are concerned, on account of the preferential absorption of chlorine by the outside fibres.

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[2] Naumann, Z. angew. Chem., 1917, **30** (1), 135.

[3] Trotman, J. Soc. Chem. Ind., 1922, **41**, 219T; 1926, **45**, 10T; 1926, **45**, 20T; and 1926, **45**, 111T.

[4] Matthews, "Textile Fibres," 1924, p. 161.

56—A COMPARISON BETWEEN THE JUDGMENTS OF INDIVIDUALS SKILLED IN THE TEXTILE TRADE AND THE NATURAL JUDGMENTS OF UNTRAINED ADULTS AND CHILDREN

By Henry Binns, F.T.I.

THE AIM OF THE INQUIRY

Three investigations, described elsewhere,* were based upon a uniformity of raw materials, which consisted of 64's and 60's merino wool, either straight or blended with 58's come-back. The variation in each range of cloths was due to blending, or to methods of combing, drawing, or spinning—variations so minute as to tax to the utmost the judgments of certain highly skilled members of the trade. The outstanding features of these inquiries were the extraordinary difficulty presented by the tests and the remarkable judgments resulting from them.

The present inquiry was originally intended as a companion to the others in that the judges were to be highly skilled; the materials in the tests, however, were to be as diverse as possible. With these conditions in mind, a preliminary selection of 50 flannels and shirtings, having varied blendings of wool and cotton, was made, and twenty persons were asked each to divide the cloths into four groups; one to be all wool, another all cotton, a third over 50% wool, and the fourth over 50% cotton. The cloths were then graded according to the selector's judgment as to the amount of wool each sample contained. This rough and ready method gave a good indication as to which samples were most easily graded and which caused most indecision. The selection of cloths for the main experiments was thereby greatly facilitated. Each sample had been used by a commercial traveller, but was in excellent condition; each also represented bulk goods which had been bought by the experimenter in the normal way of business. From the fifty samples, 30 were carefully selected and placed in groups of five, in order that each group should present opportunity for critical judgment and yet cover a wide field of dissimilar variants. Thus in the details which follow it will be seen that such factors as the blending of various qualities of wool and cotton, elasticity, threads per inch, weight, thickness, strength, colour, finish, raising, pressing and other minor items all varied. It was indeed intended by the very complexity to create a definite contrast with the other inquiries.

The persons invited to judge in the first instance were in all cases known personally to the writer, while, as an after-thought, and months after the first judges were tested, children were also asked to judge; the results stimulated a somewhat prolonged but entirely interesting series of tests, that ultimately indicated an unexpected uniformity of judgment; a fact that should be borne in mind when studying the data.

* (1) "The Discrimination of Wool Fabrics by the sense of Touch." *Brit. J. of Psychology*, January, 1926.
(2) "Measured Judgments of Practical Men in the Wool Trade." *Wool Record and Textile World*, 18/9/1924.
(3) "The Human Factor in the Judgment of Yarn and Cloth." *J. Bradford Text. Soc.*, 1920–1921.

THE JUDGES OR SUBJECTS OF THE EXPERIMENTS

Adults

Six adults from each of the following groups undertook the tests—

Groups		No. of Persons
(*a*) Woollen Trade ... (Group 5 of Table II.)	Flannel Manufacturers, Agents, Wholesale Buyers, Assistant Buyers, Drapers, and Hosiers ...	36
(*b*) Worsted Trade ... (Groups 6 and 7 of Table II.)	Wool Merchants and Topmakers, Dress Merchants, Dyers and Finishers, and Technical Experts ...	30
(*c*) Non-trade ... (Groups 12 and 13 of Table II.)	Women Inspectors, Boarding School Mistresses, Male Inspectors and Teachers, Men and Women of varied but non-trade occupations ...	30
(*d*) Sight and Touch ... (Groups 9 and 10 of Table II.)	Twelve experienced Flannel Producers and Distributors who judged by sight and touch alone ...	12
(*e*) The Experimenter ... (Group 8 of Table II.)	By touch alone ...	1
	Total Adults ...	109

Children

(*f*) Secondary School Boys ... (Group 14 of Table II.)	(i) Boarding School Boys—Form VI.; Form V., good at school work; and Form V., good at hand work ...	18
	(ii) Day School Boys—Form VI.; Form V. (two groups as above); and Form IV. ...	24
(*g*) Elementary School Boys (Group 16 of Table II.)	(i) Boarding School (Higher Elementary Standard) Boys, 50% of time on hand work ...	6
	(ii) Central Day Schools, three groups ...	18
	(iii) Elementary Day Schools, two groups, including half-timers ...	12
	(iv) Elementary Day School, very dull group ...	6
(*h*) Defective Boys ... (Group 18 of Table II.)	(i) Group of Deaf Boys ...	6
	(ii) Three groups defective boys—superior, medium, and poor ...	18
(*j*) Secondary School Girls ... (Group 15 of Table II.)	(i) Commercial School, group of Shorthand and Typewriting Students ...	6
	(ii) Day School—Form VI., 2nd year; Form VI., 1st year; and a group good at hand work ...	18
	(iii) Day School—Form VI., 2nd year; Form VI., 1st year; Form V. Lower; Form V. Commercial ...	24
(*k*) Elementary School Girls ... (Group 16 of Table II.)	(i) Higher Elementary School, 50% of time on hand work ...	6
	(ii) Art Schools, 1st and 2nd years ...	12
	(iii) Central Schools ...	6
	(iv) Elementary Schools, three groups, including half-timers ...	18
(*l*) Defective Girls ... (Group 19 of Table II.)	(i) Group of Deaf Girls ...	6
	(ii) Defectives, three groups—superior, medium, and poor ...	18
(*m*) Sundry Persons ...	(i) Art School, second experiment ...	6
	(ii) Girls, eight years old ...	6
	(iii) Imbecile girls ...	6
	(iv) Mixed group—men and boys ...	6
	Total Children ...	246
	Grand Total—Adults and Children ...	355

DATA OF THE FLANNEL AND SHIRTING TESTS

The Bradford Conditioning House kindly certified the results of chemical tests for the proportion of wool and cotton in each of the six groups of five samples, and also gave the weight per yard in ounces and drams. Thickness per inch was obtained by means of an Ashcroft thickness gauge, and microscopic measurements were made of warp threads and weft picks per inch, the mean of the two being accepted as standard.

It will be seen in Table I. that two well-defined standards were set up, one by the members of the woollen trade group, all of whom produce or distribute the cloths under review; and the other by the normal boys and girls of all groups. In addition to these two standards derived from the mass judgments of the trade and of the normal children, a third standard used is that of the percentage wool content of the cloths themselves; this is described hereafter as the "Wool" Standard. Each set of cloths was given an identifying letter (A, B, C, D, E, F), and within each set the five cloths were given the trade standard placing, i.e., A1, A2, A3, A4, A5, &c., this method making it easier to compare different gradings at a later period. The Trade Standard placing of the five cloths in each group was decided by averaging the total decisions of the trade judges (Group (*a*) only), when complete data were available. Thus cloth A1 received its number as a result of these judgments, cloth A2 coming second, and so on.

The samples when presented to the judges were privately identified by a complicated series of numbers known only to the experimenter, and which could not have conveyed any meaning to the judges. A description of the various samples is embodied in Table I., and in the last column the children's standard is inserted in order that the contrast with the trade standard may more readily be seen.

Table I.

Trade Standard	% Wool	Weight oz. drams	Thickness per inch	Warp	Weft	Children's Standard
			GOOD WOOL AND UNION SHIRTINGS			
A1 ...	(1) 100·00	(5) 4 11·5	(3) ·02435	(4x) 44	46	1
A2 ...	(5) 44·80	(3) 5 2·5	(5) ·02250	(4x) 44	46	2
A3 ...	(4) 45·70	(2) 5 2·8	(2) ·02640	(3) 41	37	4
A4 ...	(3) 48·12	(4) 4 15·5	(4) ·02350	(2) 38	37	5
A5 ...	(2) 68·42	(1) 5 13·8	(1) ·02730	(1) 38	36	3
			MEDIUM UNION SHIRTINGS			
B1 ...	(2) 40·74	(4) 4 13·8	(4) ·02405	(4) 40	39	4
B2 ...	(3) 34·39	(5) 4 10·8	(2x) ·02450	(2x) 36	40	3
B3 ...	(4) 33·51	(3) 5 2·3	(5) ·02380	(5) 42	40	5
B4 ...	(1) 46·45	(1) 5 6·0	(2x) ·02450	(2x) 40	36	2
B5 ...	(5) 22·00	(2) 5 3·0	(1) ·02520	(1) 42	34	1
			LOW UNION SHIRTINGS			
C1 ...	(1) 17·96	(2) 5 14·0	(1) ·02555	(2) 38	37	3
C2 ...	(4) 6·62	(3) 5 4·8	(4) ·02160	(5) 39	38	2
C3 ...	(5) 5·60	(5) 4 9·3	(3) ·02275	(3) 40	36	4
C4 ...	(3) 7·19	(1) 6 1·3	(2) ·02445	(1) 36	36	1
C5 ...	(2) 10·66	(4) 4 15·0	(5) ·02140	(4) 36	46	5
			COTTON WARP TAFFETAS AND CEYLONS			
D1 ...	(2) 35·10	(4) 2 11·0	(4) ·01035	(4) 72	62	4
D2 ...	(3) 28·10	(3) 3 2·5	(3) ·01345	(2) 71	55	1
D3 ...	(1) 45·89	(5) 2 8·0	(5) ·00985	(5) 90	72	5
D4 ...	(5) 16·30	(1) 3 10·8	(1) ·01490	(3) 71	56	2
D5 ...	(4) 23·54	(2) 3 4·5	(2) ·01480	(1) 68	52	3
			TWILL UNION AND COTTON SHIRTINGS			
E1 ...	(1) 16·00	(3x) 4 6·3	(2) ·01965	(3) 72	62	1
E2 ...	(3) 0·00*	(5) 4 1·5	(4) ·01735	(5) 80	62	5
E3 ...	(2) 13·53	(1) 5 5·5	(1) ·02245	(4) 74	62	2
E4 ...	(4) 0·00*	(2) 4 15·8	(3) ·01865	(2) 76	54	3
E5 ...	(5) 0·00*	(3x) 4 6·3	(5) ·01695	(1) 50	39	4
			ALL WOOL AND UNION FLANNELS (NATURAL)			
F1 ...	(1) 100·00	(3) 4 15·8	(1) ·02940	(3) 35	40	2
F2 ...	(2) 72·54	(4) 4 1·3	(3) ·02590	(4) 38	40	4
F3 ...	(3) 33·43	(5) 3 5·3	(5) ·01660	(5) 53	46	5
F4 ...	(4) 29·02	(2) 5 1·0	(2) ·02650	(2) 31	38	3
F5 ...	(5) 15·47	(1) 5 10·0	(4) ·02585	(1) 34	30	1

* Graded by quality of cotton.

THE INSTRUCTIONS AND STATISTICAL METHODS

With the adults it was almost always found necessary to conduct the experiments on their respective business premises. Telephone and personal calls interfered in some instances, but on the whole the experiments were conducted quietly and away from distraction. The tests were taken seriously and honest attempts were made to give impartial judgments.

There being only one set of samples, divided into six lots, it was impossible for the children to copy each other. In most schools a large well-lighted class-room was available where six children could be widely separated. The records were made by the experimenter, and the Head Master or Head Mistress was usually present to give information concerning each child. The tests were enjoyed, which tended to reduce any strain that the period occupied in their completion, usually an hour and a half, entailed.

The writer took up one set of samples and gave verbal instructions somewhat as follows—

I want you to try an experiment with me, in order to find how the brain, the eye, and the hand work together. Will you please arrange the cloths in front of you in what you think is their order of value. Place the one you think best at the top, then the second best, the third, the fourth, and the worst at the bottom. Wool is more expensive than cotton, so the cloth containing the most wool is most likely to be at the top and the one with the most cotton at the bottom. But these are not the only things by which you must judge. Look at each cloth carefully and handle it like this . . ., then use your judgment as to their order. *Do not take any notice of the design or of the colour.* Do not place the colour you like best at the top; judge the cloth only. You may open the cloth out like this . . . if you wish. Now do you clearly understand, or have you any questions to ask ? There is no time limit, but if you spend too long over the test you may be confused.

There appeared to be no difficulty in understanding the instructions, but where it seemed desirable, as in the case of mentally defective, deaf, or blind children, the teacher explained more fully.

In dealing with the statistics of the tests, two types of measurement are employed—

(1) *The relationship of one person's or a group of person's judgments to each other.*—Spearman's* Correlation "Foot-rule" or R- method has been used in all correlations. The formula is—

$$R = 1 - \frac{6\Sigma g}{n^2-1}$$

in which g is the numerical gain in rank of an individual in the second as compared with the first series, Σg is the sum of the gains, and n is the total number of measures.

The correlation figures recorded throughout this paper were first arrived at by the use of the R-formula above, since the data derived from the judgments of individuals or groups of individuals were substituted first in this

* The writer is aware that the "Product-Moments" method of Pearson is "the most elaborate as well as the theoretically best possible method of computing R-," but would emphasise that the larger part of statistical work on judgment done in commercial practice is upon a "distinctly limited number of measures and with un-refined measuring instruments." The method of Rank-Differences (Co-ordination), as developed by Spearman, disregards the magnitude of rank differences and considers only their relative order, but in commercial practice it is sought to indicate the trend of correlation rather than to express correlation with extreme mathematical exactitude, and Spearman's Foot-Rule offers a simple and practical method of arriving at the desired conclusions.

formula and then corrected by the *r*-formula proposed by Spearman as follows—

$$r = \sin\left[\frac{\pi}{2} R\right]$$

tables for which may be found on page 402 of Rugg's "Statistical Methods Applied to Education" and in other works of a similar character. An actual example of a calculation is given.

A couple of rankings secured from two judges were—

Cloths	Rankings— 1st Individual	2nd Individual
A1	3 ...	1
A2	1 ...	2
A3	2 ...	3
A4	4 ...	4
A5	5 ...	5

Cloth A1 by the judgment of the second individual has gained in rank two places which for purposes of arriving at a correlation is recorded as +2. Cloths A2 and A3 have lost rank, and cloths A4 and A5 experienced no change. The significant figure is therefore the gain of two places which represents Σg. There have been five measures and the formula can now be completed thus—

$$R = 1 - \frac{6 \times 2}{25 - 1}, \text{ i.e., } R = 1 - \frac{12}{24} \text{ or } 1 - \cdot 50 \quad \therefore R = \cdot 50, \text{ i.e., a plus } (+) \text{ correlation.}$$

This, corrected in the manner referred to above gives a final figure ·732. It should be noted that the correlation secured is one of agreement (plus). As explained in the footnote on page T618, figures given throughout this paper should be read as indicative of trend of correlation rather than mathematically accurate measures of relationship.

(2) *The Relationship of one Cloth to another Cloth in a Range of Samples.*— In order that there should be no confusion with the measurements for personal judgment, the average placing of the various groups is translated into a percentage scale in which a unanimous vote on the best or worst cloth is represented by 100% or 0% respectively. A formula to meet the requirements has been derived in practice and is—

$$\frac{100\ (n - \text{A.P.})}{n - 1}$$

in which A.P. represents the average place of the grading of cloths by the group as a whole, and *n* the total number of measures. An example is given to illustrate the calculations made throughout.

Cloths	Rankings of Six Individuals *a*	*b*	*c*	*d*	*e*	*f*	Average Place	% Place derived from Formula	Ranking
A1 ...	3	3	3	3	3	3	... 3·00 ...	50 ...	3
A2 ...	1	2	1	1	1	1	... 1·16 ...	96 ...	1
A3 ...	2	1	2	2	2	2	... 1·83 ...	79 ...	2
A4 ...	4	4	4	4	4	4	... 4·00 ...	25 ...	4
A5 ...	5	5	5	5	5	5	... 5·00 ...	00 ...	5

THE MASS JUDGMENTS OF THE CLOTHS BY THE TRADE AND BY CHILDREN

It was desirable to know at the outset the main differences in the average opinion of the two chief groups. The technico-practical men were represented by 36 judges, giving 30 judgments each, equalling 1,080 units; the children, including all the normal boys and girls, and excluding all defectives, numbered 174 giving 30 judgments each, made a total of 5,220 units. These two groups

Table II.

(a) Chemical Tests and Mechanical Measurements

Physical Standards	Correlation with Trade Standard: Ranges of Cloths A	B	C	D	E	F	Average	Correlation with Children's Standard: Ranges of Cloths A	B	C	D	E	F	Average
1—Wool percentage	·00	·46	·00	·46	·94	1·00	·48	·46	·00	·00	−1·00	·94	−·48	−·01
2—Weight	−·48	−1·00	·00	−1·00	−·63	−1·00	−·68	−·48	·46	·75	·75	·62	·94	·51
3—Thickness	−·48	−·63	·75	−·48	·46	·46	−·01	−·48	·98	·94	·75	·75	·46	·57
4—Threads (fewest)	−1·00	−·63	·00	−·48	−1·00	−1·00	−·68	−1·00	·98	·94	·75	·00	·94	·43

(b) Judgment Tests

Groups of Judges	Correlation with Trade Standard: Ranges of Cloths A	B	C	D	E	F	Average	Correlation with Children's Standard: Ranges of Cloths A	B	C	D	E	F	Average
5—Woollen group : trade standard	1·00	1·00	1·00	1·00	1·00	1·00	1·00	·75	−1·00	·46	−·48	·46	−·48	−·05
6—Worsted group	·75	·75	·75	·94	·94	·94	·84	·94	−·48	·46	−1·00	·75	−·48	−·03
7—Dyers group	·75	·46	·86	·00	·00	·62	·45	·00	·46	·46	·94	·94	−·63	·36
8—Touch only (Experimenter) ...	·46	·94	·75	−·48	·94	·94	·59	·00	−1·00	·46	·94	·75	−·48	·11
9—Touch only (12 experts) ...	·75	·62	·00	−·48	·15	·86	·32	·00	−1·00	·27	·15	·62	−·48	−·07
10—Sight only (12 experts) ...	·46	·46	·00	−1·00	·86	1·00	·30	·75	·00	·75	·46	·75	−·48	·37
11—Blind women	·46	−·48	·46	−1·00	·46	·75	·11	·46	·00	·98	·62	·46	·46	·50
12—Women (non-trade)	·46	·94	·46	·75	·46	1·00	·67	·46	−·48	·00	·00	·75	−·48	·04
13—Men (non-trade)	·00	·46	·75	−·48	·75	·00	·25	·46	−·48	·46	·94	·75	·46	·43
14—Boys (Secondary)	1·00	−1·00	·75	−·48	·46	−·48	·04	·75	·94	1·00	1·00	1·00	1·00	·95
15—Girls (Secondary)	·46	−1·00	·46	−1·00	·46	·46	−·03	·94	·94	1·00	1·00	1·00	·75	·94
16—Boys (Elementary)	·94	−1·00	·75	−1·00	·75	−·48	−·01	·94	·94	·94	·75	·94	1·00	·92
17—Girls (Elementary)	·75	−1·00	·46	−·48	·46	−·48	−·05	1·00	1·00	1·00	·75	1·00	1·00	·96
18—Boys (Defective)	1·00	−1·00	·75	−1·00	·46	·46	·11	·75	1·00	·94	·75	1·00	·75	·87
19—Girls (Defective)	·00	·94	·46	−·48	·00	·00	·15	·46	−·48	·00	·75	·75	·75	·37

may be regarded as typifying skilled and untrained judgments. How then did they estimate the value of the various cloths? In mass there was a pure chance agreement between the two groups at —·05, which indicated two well-defined standards of judgment, (1) by the woollen trade group, each member of which was familiar with all the types of cloth from the manufacturing or distributing point of view; and (2) by normal boys and girls. The physical standards against which these variations may be measured are—

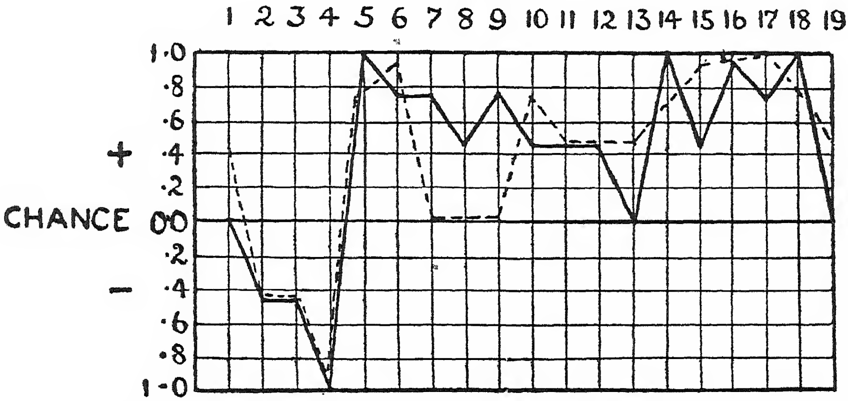
(1) The percentage of wool in the cloths.
(2) The weight of the cloths.
(3) The thickness of the cloths; and
(4) The smallest number of threads per inch.

In addition a comparison is made with the judgments by sight alone, and by touch alone, of a dozen trained persons, and judgments by the experimenter with continuous practice. Such mass results are given in Table II.

The "Trade" figures imply that judgments are moderately influenced by the presence of wool; that they are not biassed by sightliness or handle, apart from the construction of the cloth as a whole; and that lightness of weight, thinness of cloth, and fewness of threads per inch are all taken duly into account; experienced technical judgments have been exhibited.

On the contrary, the children's figures show that the presence of wool has no direct influence, but that softness, associated with wool, has been confused with softness produced by finish. Compared with the sight and touch judgments by experienced men, those of the children exhibit definite detailed differences in each range, indicating a different type of judgment, probably due to confusions such as that mentioned above. Children have a bias towards weight, thickness, and incidentally, towards fewness of threads per inch. A "natural" judgment without technical knowledge is clearly indicated. The main points of difference between the trained and untrained judgments are brought out in Graphs I. to VI. following*—

GRAPH I: RANGE A.

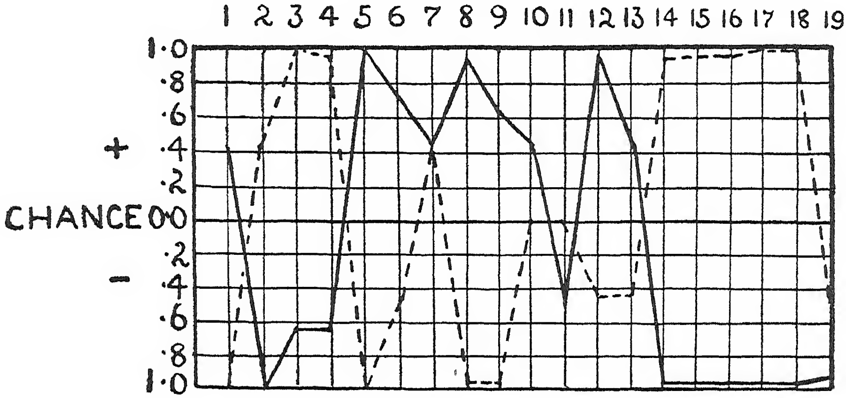


The judgments of trained adults (Groups 5–10), of untrained adults (Groups 11–13), and of children (Groups 14–19), are based on one or more of the physical factors of which the results of chemical and mechanical tests are indicated in Groups 1–4. The direct relationship is shown at 5.

* In Graphs I. to VI. the solid line represents the expert woollen trade relationship, and the dotted line the children's relationship, with the other groups. The higher the curve the greater is the agreement; the lower the curve the more pronounced is the disagreement; the nearer the centre, the more chance operates.

Graph I.—Range A consisted of five wool and super-union flannel shirtings having 100%, 62%, 48%, 46%, and 45% wool respectively. These were graded by 14 groups of trained and untrained adults and of normal and defective boys and girls. One trained group judged by sight alone without handling, and by touch alone without looking at the cloths; the experimenter conducted a number of trials by handling only. The results show no actual disagreement, all correlations being positive between 0·00 and 1·00; the average being ·5. The general tendency is for the trained groups to follow the trade standard, and for the children to be uniform in their judgments which are quite strongly in agreement with the trade opinion. Where the handle of the cloth is specially considered the unconscious bias of trained men is obviously due to their trade experience, and in the case of the blind women the bias was towards judgment upon the wool content mainly. Making judgments in which both sight and touch are used, the most experienced people do not judge on wool alone, other technical details undoubtedly being considered. Children are influenced to a large extent by the presence of wool, which, in this instance, appears to have been the determining factor in the high correlation of ·75 between the two gradings of the five cloths.

Graph II: Range B



The main groups are disagreed, this being indicated by a complete reversal of the criteria of the children and those of the trade (5). The judgments of normal children are remarkable solid (14–18). The trade is strongly influenced by the wool percentage (1), but children appear to judge by finish, weight, and other superficial factors (2–4).

Range B (see Graph II.) consisted of medium union shirtings of a similar thickness to range A but having a smaller precentage of wool, viz.—46%, 41%, 34%, 33%, and 22%. The groups of judges are the same in each case. It will be noted that there is a very definite and uniform difference between the "adult" and "children" groups—untrained men and women judging with the trade, and blind women judging similarly to the children. Exceptions of note being the dyers who have a bias towards the natural judgment of the children; and the defective girls who are in solid agreement with the trade, and in disagreement, therefore, with other children, including defective boys. This variation between defective boys and girls might be significant in the light of fuller knowledge of their respective training; other investigations have indicated such a possibility.

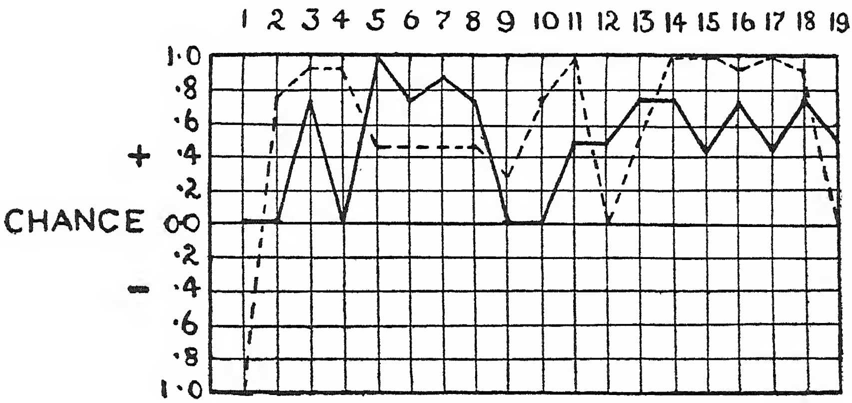
Contrasting ranges A & B by averaging the correlations of each group with the three main standards, it will be seen that whilst wool enters into the

judging of both ranges of cloth, there are other factors which cause the trade and the children to be moderately agreed in one case and not in agreement in the other.

		Range A.		Range B
Group Averages correlated with Trade Standard	...	·55	...	— ·02
,, ,, ,, "Wool" ,,	...	·38	...	·23
,, ,, ,, Children's ,,	...	·57	...	— ·01
	Average	·50	...	·07

The least costly of the cloths having 22% wool was considered to be the best by 78% of the normal children, who were of different ages and came from various districts and schools; they had had, of course, varied types of training. The trade adjudged this cloth to be definitely the worst of the five samples. On the market, despite the opinion of buyers that it was not, technically, a good cloth, this cloth sold remarkably well on its merits. Two other cloths were made from the same Belgian warps with British wefts, one being more closely set than the other. Both the trade and the children found that containing the most material to be "boardy" and inferior despite its increased cost. All the cloths were strong and serviceable and it appears that superficial value attracted the natural judgment of the children, whilst the trained judges were influenced by other factors of a technical nature.

GRAPH III: RANGE C.

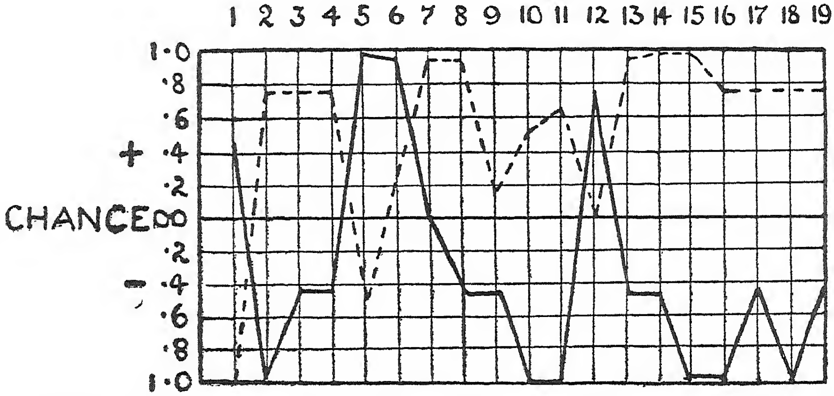


Though there is a positive correlation throughout, the trade does not judge by wool content (1) and the children even favour cotton. Production costs determine the trade opinions; the children judge by softness and similar factors. From different points of view more or less uniform judgments result.

Range C (see Graph III.) consisted of low union shirtings containing 18%, 11%, 7%, 6%, and 5% only of wool. Weight, thickness, and appearance seem to have been the dominant factors influencing the children's judgments; factors which had no influence on the trade. The small quantity of wool played no part in the decisions of either. The trade appears to have decided entirely by the actual cost of manufacture. The children, however, with great unanimity (78%) selected a heavily-pressed, smartly-finished cloth as best, with another cloth having a kindly handle and being slightly raised, with little pressing, as almost equal to it. This points to a "natural" handle caused by finish, with characteristics of a different type from a trade or technical handle. This is confirmed by the fact that another cloth was

valued at 20% by the trade and at 15% by the children showing only a small difference on a dead, cottony, bare, and stiff cloth which "grinned."

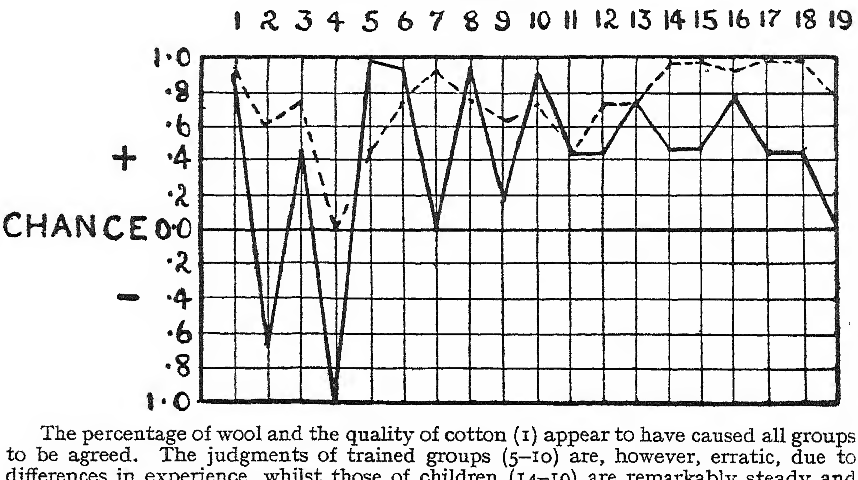
GRAPH IV: RANGE D.



A definite conflict of opinion exists between the trained woollen and worsted groups (5 and 6) on the one hand, and the untrained groups on the other. The former are influenced by technical and the latter by sensory factors. The steadiness of the children's groups (14–19) is surprising. Non-trade women, no doubt as a result of experience, deviate from the other untrained groups and correlate very highly with the expert groups (12, 5, and 6).

Range D (see Graph IV.) were cotton-warp taffetas and ceylons with 46%, 35%, 28%, 23%, and 16% wool in them. Taffetas were of the "papery" type of cloth, and ceylons of the fine but soft type. The trade put aside all superficial effects, preferring the most costly cloths with a strong bias to wool. There was considerable confusion in the minds of trade judges—as might be expected on so complex a range—which is indicated by a difference of only 19% out of a possible 100% between the best and the worst of the five cloths. The children had no such hesitation, showing a decision of 59%. It is remarkable also to find that 72% of the children, of different ages, sexes, and schools, selected the same cloth as first choice.

GRAPH V.: RANGE E.

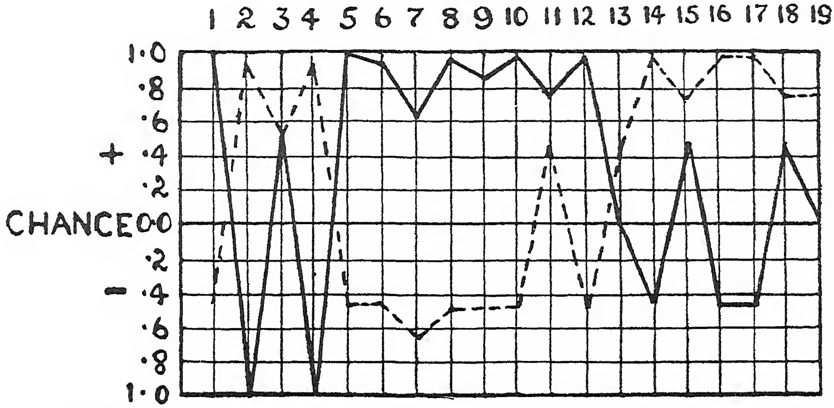


The percentage of wool and the quality of cotton (1) appear to have caused all groups to be agreed. The judgments of trained groups (5–10) are, however, erratic, due to differences in experience, whilst those of children (14–19) are remarkably steady and solid. Reasoned calculations are, in the main, in accord with the appeal to the senses of sight and touch.

The explanation appears to be that the actual cost per yard is known by technical men at a glance, to be low.

Range E (see Graph V.) was selected to allow of a comparison of cloths with 16% and 14% wool with similar types of all cotton cloths, one of which had a special "all-wool" finish. The most costly cloth to produce, having 16% wool, was selected as a first choice at 86% by children and 66% by the trade; the next best at 73% by the children, and 53% by the trade. A superior all-cotton cloth with a special wool finish was placed third by the trade, and fifth by the children. Technical consideration of the quality of the cotton cloth and its construction and of the fineness of finish probably determined the judgment of the trade. The contrasts of loftiness and "paperiness" have, on the contrary, had the greater influence on the children.

GRAPH VI: RANGE F.



A comparison of (1) and (5) indicates that experienced traders have judged absolutely by wool content. In detail the whole of the trained groups (5–10) are in contrast with the children (14–19) on two consistent levels of judgment. Technical rather than superficial considerations are indicated.

Range F (see Graph VI.) consisted of natural flannels with varying percentages of wool, i.e., 100%, 72%, 33%, 29%, and 15%. Persons having had experience in the trade, graded these cloths in this order almost perfectly as follows—

Average of 66 trade judgments with 12	"sight" judgments of	1·00
,, ,, ,,	"touch" ,,	·83
,, ,, ,,	"wool tests" ,,	1·00

The children's judgments are totally different as will be seen from the following table in which the percentage of wool is directly compared with the average placings of 66 trade judges and of 174 normal children.

Cloths	Percentage of Wool	Trade	Children
F1	100% (1)	88% (1)	73% (2)
F2	72% (2)	73% (2)	42% (4)
F3	33% (3)	52% (3)	12% (5)
F4	29% (4)	23% (4)	44% (3)
F5	15% (5)	14% (5)	79% (1)

The grading by children is almost the reverse of that by the trade, and it will be observed that F5 with only 15% of wool is preferred by the children to F1 which was all wool. F5 had a cotton warp and a mixed weft. It was of low commercial value yet was preferred to F2 which also had a cotton warp but a botany weft and an ordinary finish.

THE BASIC FACTORS OF JUDGMENT

Experienced members of any section of the wool trade base their judgments on a complex set of widely varying factors. Though, fundamentally, certain factors are common to all, yet there is a margin for individual factors due to the type of material habitually bought and sold by each person. Children, as has been shown already, exercise a striking uniformity of judgment which would seem to possess a dominant common factor. This factor would seem to be directly concerned with the superficial and sensory aspects of the cloths judged. As these two types of judgment are almost completely at variance, it will probably be helpful to trace the point at which division between them occurs.

Comparison of the placings allotted to cloths B5 and F5 will show that the trade judges decided both were the worst in their groups; the children on the contrary place them first. Cloth B5 had a pale green stripe on a 4 and 4 natural and white ground. It had a cotton warp and a mixed weft. F5 was a plain natural flannel with mixed warp and weft. Neither colour nor character of warps were common factors; the cloths differed also in wool content, weight, threads, and thickness. The raised and pressed finish, together with treatment with specially soft water common to both cloths, has apparently attracted the children, though these cloths were judged in different groups. The regularity of grading of the two cloths is remarkably demonstrated in Table III.; the percentages indicating the value placed upon the cloths by each group of judges.

Table III.

Groups	Cloth B5 Percentage	Cloth B5 Rank	Cloth F5 Percentage	Cloth F5 Rank	Average
Woollen Trade	21	1x	14	1	27%
Worsted ,,	36	3	39	3	
Non-trade Females	21	1x	18	2	38%
,, Males	56	5	56	4x	
Secondary School Boys	81	9	81	9	75%
,, ,, Girls	65	6	74	7	
Elementary School Boys	80	8	77	8	82%
,, ,, Girls	86	10	85	10	
Defective Boys	77	7	61	6	60%
,, Girls	48	4	56	4x	

The uniformity is very marked and the agreement in terms of group ranking may be put at a correlation coefficient of ·98. Those experienced in handling this type of cloth dislike both samples; a dislike shared by the worsted section of the trade. Non-trade males were indifferent to either cloth but the females disliked them to a degree comparable to that of the woollen trade experts. The probable explanation being that the women were familiar with these cloths from the laundry point of view; their judgment was in that respect technical. Normal boys and girls were in fair agreement as to the excellence of these cloths but, as might be expected, the defective children were undecided. The tailoring training received by defective boys tended to raise their judgment more nearly to that of the normal children. It is suggested that there is a well-defined technical judgment distinct from an equally well-defined natural judgment, and the point of separation may be said to be represented by the judgment level of the untrained or non-technical adult. If it be said that such samples as these, or still more carefully chosen ones, are useful in the disclosure of natural ability, it should be borne in mind that the standard is already high in

normal children and that their decision to place such samples as B5 and F5 first in their groups, gives no indication of their proneness to judgments contrary to those of the trade. If, however, the highest trade skill can be shown to rest upon an innate natural ability, then the few simple basic factors of judgment may be measured in the untrained boy or girl. The difference between non-trade women at a 19% average and men at 56% in the estimations of cloths B5 and F5 suggests caution in assuming that selection may be made satisfactorily among adults by the use of such samples as those now being considered. The value of an empirical training must not be overlooked, for though it may not reach the all-round stability of a definite technical training, it may approximate to it in some respects. A more exact knowledge of the constituents of natural ability and its relation to the most delicate trained ability, obtained by similar means to those used in these experiments, might at least help to supplant a more or less "trial and error" judgment by a stable and relatively exact judgment.

CHARACTERISTICS OF GROUP JUDGMENTS

In previous inquiries certain group characteristics were found to exist. A much wider field now offers a further and perhaps better opportunity for tracing the effects of special types of training or experience upon different groups. It has already been pointed out that there are two distinct standards of judgment.

(*a*) The "Trade" judgment, determined by those persons producing or distributing the goods under consideration. This judgment is based on the quality and proportion of wool or cotton present in the cloth; upon cost of production; on appearance and handle, determined by experience or technical training.

(*b*) The "Children's" (or "natural") judgment, based on the superficial factors of finish (all of which influence the senses of sight and touch), weight, thickness, and threads. As requested in the instructions given (see page T618), the small degree of colour introduced has been shown to have been ignored.

These two standards together with the "wool" standard (see page T617) will be adhered to in the following analysis which deals with the groups in rank, from the most highly trained to the most defective persons.

(A) The Trade or Trained Judgment

(1) *The Woollen Trade Group.*—Business men will appreciate the fact that the thirty samples in these tests were produced in the West Riding of Yorkshire, Lancashire, and Scotland. Home and foreign yarns were used and the finishing was in most cases done by commission finishers and not by the manufacturers. Correlations of the judgments of this group with those of the three standards of judgment are given in Table IV.

Table IV.—Woollen Trade Group

	Standards		
	Trade	"Wool"	Children
Flannel Manufacturers	·54	·30	— ·18
,, Agents	·40	·29	— ·07
,, Buyers	·63	·34	— ·14
,, Assistant Buyers	·45	·07	— ·11
Hosiers (men's wear)	·48	·15	·01
Drapers (women's wear)	·34	·15	·02
Average	·47	·22	— ·07

Confirmation is again obtained of a fact, previously noted, that wholesale flannel buyers and manufacturers (none of whom made more than a small proportion of the goods judged) are the best judges. Assistant flannel buyers are usually on a lower level of judgment than buyers, mainly, it is suggested, because of less responsibility and experience. Drapers are relatively low on account of their lack of technical knowledge and their training does not appear to have the same influence when making judgments upon matters outside their specific occupation. The greater the technical skill the higher is the agreement with tests for wool. In all cases there is disagreement with the children's judgment.

(2) *The Worsted Trade Group.*—The Bradford Worsted Industry is so highly specialised that each branch is carried on independently of the others, quite unlike the woollen trade, in which nearly all the processes are carried out by one firm under one roof. A lower standard of judgment might therefore be expected from a member of any particular worsted section. On the other hand, as all are well-informed on wool characteristics some agreement with the woollen trade might be looked for. The agreements with the standards are shown in Table V.

Table V.—Worsted Trade Group

	Standards		
	Trade	"Wool"	Children
Woolbuyer, Woolsorter, Topmaker, two Spinners, and a Yarn Agent ...	·20	·16	·23
Dress Goods Manufacturers ...	·34	·15	− ·06
,, ,, Wholesale Buyers ...	·53	·36	− ·10
,, ,, Dyers ...	·33	·16	·22
Technologists and Analysts ...	·18	·13	·24
Average ...	·32	·13	·11

The Worsted Group, however, shows a definite falling-off in judgment as compared with the Woollen Group; their agreement with wool tests is also less, whilst they are in slight but definite agreement with the children. Wholesale buyers of dress goods are again the best judges of the flannels and shirtings, showing that an all-round training in the buying of dress fabrics is to a large extent "transferable" to the kindred, yet different, branch of washable woollens. It is significant also that the judgments of those trained only in the analytical testing of wool or wool fabrics by mechanical appliances, have little agreement with either the trade, wool, or children's standards. This is probably due to the fact that personal opinion is not recognised as part of their duties; opinions may only be expressed by them on recorded facts. Buyers rely solely on personal judgment, which masses the large number of factors under the one factor of price. Each method has its advantages, but it would appear that personal judgment is decreased in value when methods of mechanical testing are relied upon.

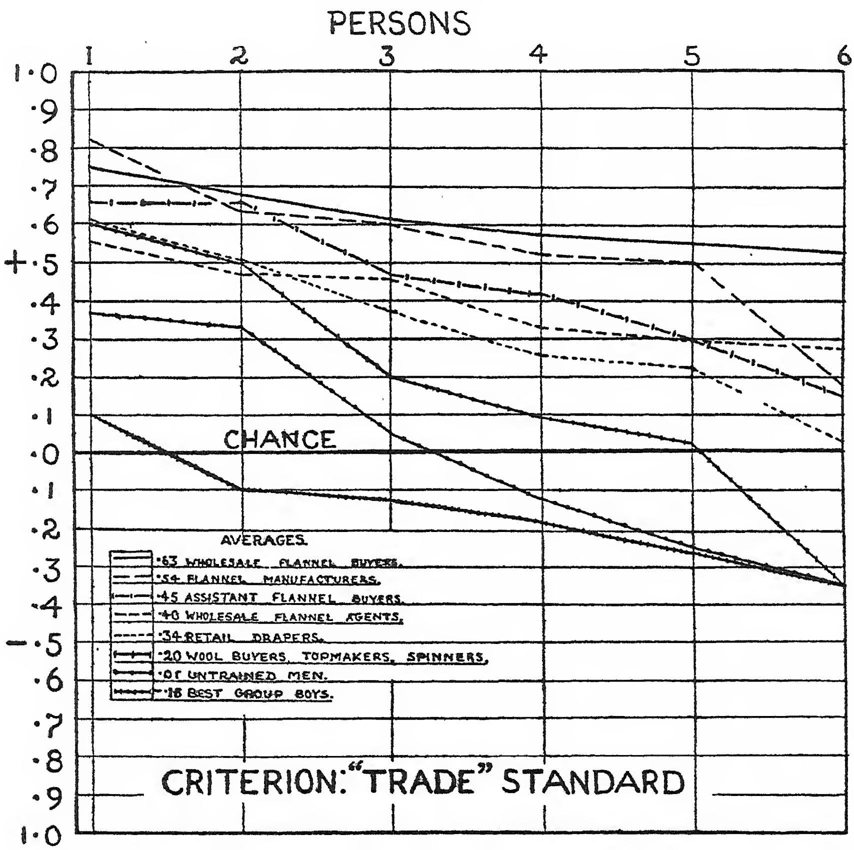
(3) *Non-trade Adult Group.*—This group had neither the advantage of a trade experience nor the total inexperience of boys and girls. Each person held some responsible position in academic or professional life and there can be no doubt as to their high intellectual ability. A comparison with the standards is given in Table VI.

Table VI.—Non-Trade Adults

	Standards		
	Trade	"Wool"	Children
Women Inspectors and Superintendents	·15	·11	·07
Music and Physical Culture Mistresses	·48	·31	— ·01
Housewives, Typists, &c.	·32	·27	— ·14
Male Inspectors and Teachers	·01	·04	·05
Professional Men, Journalists, &c.	·17	·03	·21
Average	·23	·14	·03

Again, as might be expected, this group is on a lower level than the Woollen and Worsted Groups. The women (among whom were music mistresses) gave moderately high results to both trade and wool standards, but show a chance relationship with children. On several occasions music

Graph VII.



Graph VII., showing the variations between the scoring of 48 persons and their group averages compared with the "Trade" Standard of Judgment. The curves of the five groups below are omitted to avoid confusion.

·53—Wholesale Dress Buyers.
·48—Retail Hosiers.
·34—Dress Goods Manufacturers.
·33—Dyers and Finishers.
·18—Technical Analysts.

enthusiasts have shown high records on tests involving mental interpretation through the senses of sight and touch. Later experiments on wire, &c., confirm the view that where the sight and touch senses are closely co-ordinated in one sphere of activity, a sensory judgment of a higher value in other spheres may be secured. Professional men, journalists, education inspectors, and teachers, who use the sense of sight more than that of touch, give almost zero records with both the trade and children standards. From a purely intellectual standpoint this group is probably superior to the whole of the other judges under review, but in no other group is this lack of decision so noticeable except perhaps in the case of six blind women whose faculties were incomplete and therefore not co-ordinated. A similar characteristic has been already seen to exist in the case of expert technical analysts using mechanical testing appliances. Virtually, both groups are therefore the cream of the scientific and education sections. Neither group needs the active co-operation of the mind-sense faculties, which has continually been shown to be vital in wool trade judgments. This appears to strengthen the assumption, often freely made, that the healthy balance of all faculties is essential to a sound judgment of samples used to supplement a verbal statement.

The term "mind-sense" has been previously used* and is here also used, to indicate the power of the normal, intelligent, human mind working in conjunction with the senses of sight, touch, hearing, smelling, and tasting. This power or function can concentrate along one or all of these five routes and can thus consciously or subconsciously weigh combined evidence in one operation quickly. "Mind-sense" is the common means of measurement by all human beings and for certain measurements is perhaps the only one available, e.g., for "handle"—a vital measurement in wool and fabrics judgments.

(B) The Children's or Natural Judgment

(4) *Secondary School Boys' Group.*—The next step was to compare natural and untrained judgments with the previously-analysed trained judgments. Three groups were tested at a well known Secondary Boarding School and four groups at Secondary Day Schools in Bradford. Table VII. shows the clearly marked distinction between the trade and children's standards.

Table VII.—Secondary School Boys

		Standards		
	Form	Trade	"Wool"	Children's
(*a*) Boarding School ...	VI. Intellectual bias ...	·03	— ·05	·46
,, ,, ...	V. ,, ,, ...	— ·02	— ·15	·25
,, ,, ...	V. Handwork bias ...	— ·08	— ·06	·66
(*b*) Day School ...	V. Intellectual bias ...	·03	— ·09	·75
,, ,, ...	IV. Handwork bias ...	·02	— ·04	·53
,, ,, ...	V. Intellectual bias ...	·04	— ·02	·66
,, ,, ...	IV. Handwork bias ...	— ·13	— ·11	·74
	Average	— ·01	— ·08	·58

An attempt has been made to obtain groups with intellectual and handwork bias, but this was not so easy to secure as might appear. The best boys at school work are usually studying hard for examinations and have

* "Measured Judgment of Practical Men in the Wool Trade," *Wool Record and Textile World*, 2nd October 1925.

little time for handwork. It was decided to adhere to the principle of testing those doing the best at school-work in one group, even though those with handwork ability had to be taken from a lower form. In school (*a*) where hobbies are cultivated, and artistic work of all kinds is encouraged, those favouring handwork gave to these tests the highest agreement with the children's standard at ·66 whilst their colleagues engaged in more general book work, showed correlations at ·46 and ·25. In the day schools there is a balance in favour of the intellectually inclined boys of ·75 against ·53, which may be due to the lower mental capacity of the latter as shown in the fact that they are in a lower form. Whilst there is no relationship in either of the groups with Trade or Wool Standards, there is an average agreement with the Children's Standard of ·58.

(5) *Secondary School Girls' Group*—It was difficult for headmistresses to select girls specially gifted in needlework or handwork, as so small a proportion of Secondary School time is devoted to it. Table VIII. shows the characteristics previously observed in the Secondary School Boys.

Table VIII.—Secondary School Girls

School	Standards		
	Trade	"Wool"	Children
(*a*) A Commercial School of Typewriting and Shorthand	— ·16	— ·06	·61
(*b*) Day School ... VI. Intellectual, 2nd Year ...	·11	·16	·63
,, ... VI. ,, 1st Year	— ·10	·03	·53
,, ... V. Handwork	— ·08	— ·03	·56
(*c*) ,, ... VI. Intellectual, 2nd Year	— ·03	·02	·75
,, ... VI. ,, 1st Year	·02	— ·03	·53
,, ... V. ,, 1st Year	— ·09	— ·05	·47
,, ... V. Commercial Form	·06	·18	·50
	— ·03	·08	·57

It would appear that in two schools (*b*) and (*c*), Form VI., the second year girls are better according to the Children's Standard than the first year's Form V., or the Commercial Form in the Secondary School (*c*). But the judgments are better in the purely Commercial School (*a*). It has been argued that girls of 16 to 19 years of age handle the type of cloths used in these tests at home, and in consequence the experiments cannot be regarded as entirely impartial between girls and boys. The data clearly show, however, a most emphatic bias to the Children's Standard, and the judgment is in no way associated either with the percentage of wool or the Trade Standard. The differences in Tables VII. and VIII. show decidedly that these Secondary School Girls—all of ability at school—judge decidedly and yet superficially in contrast to the Music Group (page T629), which is in the direction of the Trade Standard. There is no sex difference recognisable in the judgments between boys and girls.

(6) *Elementary School Boys' Group*—In this group are boys at a Higher Elementary Boarding School where half the school time is devoted to handwork of some kind; in addition, a special feature is made of hobbies. At another school, five out of the six boys tested were half-timers at a spinning mill, whilst another group was selected because of the dullness of its members. Three groups are in good "Central" Schools.

Table IX.—Elementary Schools Boys

	Standards: Trade	"Wool"	Children
(*a*) Higher Elementary Boarding School—50% hand work	− ·15	− ·05	·76
(*b*) Central School—Intellectual Group	− ·04	·11	·54
,, Handwork Group	·02	− ·01	·51
(*c*) Central School	− ·01	− ·09	·37
(*d*) Elementary Hill School (five half-timers)	− ·05	− ·02	·49
(*e*) Elementary City School	·09	− ·03	·64
(*f*) Elementary Dull Boys	·01	·05	·26
	− ·02	− ·01	·51

On balance, there is a small lowering of ability as compared with Secondary School Boys, but the main feature is the high standard of school (*a*), where half the time is devoted to handwork, the correlation being ·76. In contrast, boys known to be dull score very low at ·26. Between extremes there is considerable variation or lack of stability, this being an indication of a lower standard of judgment. School (*a*) are sharp boys; at school (*c*) boys had been transferred from other schools and were said to be below standard; standard (*b*) may suffer from the same cause; the half-times in school (*d*) do not seem to have been influenced unduly by working at the mill.

(7) *Elementary School Girls' Group*—The girls were taken where possible from the same schools as the boys, with the replacement of two Central School Groups by two Art School Groups, the latter being engaged in dress-making and similar practical work.

Table X.—Elementary School Girls

	Standards: Trade	"Wool"	Children
(*a*) Higher Elementary Boarding School—50% handwork	− ·16	− ·09	·75
(*b*) Art Schools—2nd Year	− ·04	− ·04	·72
,, 1st Year	− ·04	·02	·54
(*c*) Central School	− ·20	− ·20	·63
(*d*) Elementary Hill School (two half-timers)	− ·14	− ·06	·69
(*e*) Elementary City School	− ·03	− ·13	·73
(*f*) ,, ,, ...	− ·06	− ·03	·54
(*g*) ,, ,, (sharp, 8 years of age) ...	− ·03	− ·11	·43
	− ·09	− ·08	·63

Most of the children in this group spent half or the whole of school time in some form of handwork, and their teachers suggested that girls at these ages and from this type of home are usually more engaged in housework or needlework than are girls from Secondary Schools and, of course, than boys from the same homes. This may account for the very stable figures shown above. It would appear that general intelligence has much to do with sound judgment, in that dull boys of 14 years of age only score ·26, whilst sharp eight-year old girls score ·43. Second year Art pupils are ·18 higher than first year pupils, a feature frequently noted and pointing to the value of this kind of training.

(8) *Defective Boys' Group*—One set of children were deaf and the other three sets were described as "Superior," "Medium," and "Poor" by the headmaster.

Table XI.—Defective Boys

	Standards		
	Trade	"Wool"	Children
(*a*) Deaf Children	·31	·10	·26
(*b*) Mentally Defective (Superior)	– ·04	– ·07	·50
,, ,, (Medium)	– ·10	– ·12	·44
,, ,, (Poor)	·14	·00	·20
	·07	– ·02	·35

The ranking of these groups suggests a striking similarity to Intelligence Tests results. These children were not included in the figures from which the Children's Standard was obtained, and yet there is the high score of ·50 from the "Superior" Defective Group. The bias towards Trade judgments in those with least intelligence seems, in the opinion of the experimenter, to have been arrived at, indirectly, by the surface feel of wool. It has already been shown that judgments showing poor agreement with the Children's Standard do not necessarily imply greater agreement with the Trade or Wool Standards. As the latter rise or fall together a technical judgment seems to be indicated by either of them. As a dividing line occurs between the trained and untrained adult, and even between persons in the wool trade using mechanical appliances, and those whose experience has been gained by personal judgments, so it may be that another division occurs between a certain level of mind-sense ability and another level in which mind or sense are missing. The headmaster of this particular Defective School is a keen follower of Sloyd. The training is centred on tailoring, bootmaking, and other manual work, including gardening. The handling of fabrics by women dress-fitters and by the adult blind give parallel results with the best of the children here quoted. Manufacturers and buyers of wool textiles give higher records than other groups which get less experience in judging the appearance and handle of fabrics.

(9) *Defective Girls' Group*—Similar groups to those of the boys were tested at the girls' schools.

Table XII.—Defective Girls

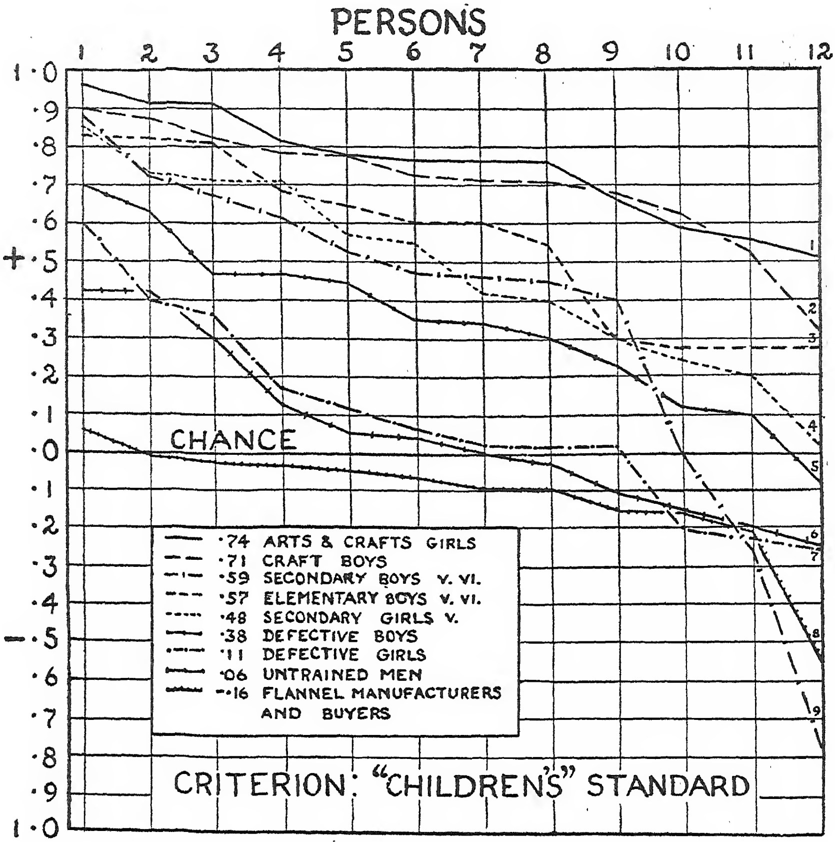
	Standards		
	Trade	"Wool"	Children
(a) Deaf	·06	·00	·46
(b) Mentally Defective (Superior)	– ·10	– ·16	·28
,, ,, (Medium)	·17	·17	·06
,, ,, (Poor)	·13	·05	– ·07
	·06	·01	·21

The general level of the girls is lower than that of the boys, partly owing to the fact that less handwork, of the type likely to be helpful in these tests, is done. The girls all seemed to be of lower intelligence than the boys, though the deaf girls are decidedly better in this respect than the boys. The ranking of the three Defective Groups is in order of the headmistress's ranking by intelligence. The same characteristic regarding the "Wool" Standard is again shown by the girls.

(C) Touch Judgment of All the Thirty Cloths by the Experimenter

Twenty-four trials were made by the experimenter by touch alone in four groups of six judgments each, in order to make comparison with other groups. The results are given in Table XIII.

GRAPH VIII.



Graph VIII., showing the variations between the scoring of 108 persons and their group averages, compared with the "Children's" Standard of Judgment. The curves of the four groups below are omitted to avoid confusion.

·71—V.-VI. Elementary Girls.
·69—VI. Secondary Girls.
·70—V. Secondary Boys.
·36—Deaf Boys and Girls.

Table XIII.—Experimenter's Touch

	Standards: Trade	"Wool"	Children
Average—1st Set of Six Trials ...	·36 ...	·16 ...	— ·10
,, 2nd ,, ,, ...	·50 ...	·18 ...	·11
,, 3rd ,, ,, ...	·48 ...	·23 ...	·04
,, 4th ,, ,, ...	·58 ...	·09 ...	·05
	·48	·16	·02

A serious effort was made by the experimenter to select the softest cloths and to put aside, as far as possible, a trained decision. As practice increased so did the attempt to lay aside experience diminish, as will be seen by the progressive approach after each series to the Trade Standard. In addition, the stability also increased, e.g.—

The first set of six trials were ...	·26	·23	·34	·49	·47	·36
,, last ,, ,, ...	·52	·54	·63	·59	·57	·66

The twenty-fourth trial, being the last, was best and nearest also to the Trade Standard. This does not necessarily imply that this improvement coincides with an improvement from the Wool Standard, as is seen in the drop from ·23 to ·09. At the same time it is possible when drawing nearer to the Trade Standard to increase the agreement with the children from — ·10 to ·11. This seems to indicate that a particular training or experience dominates the judgment in spite of an effort of the will to be impartial. This was also strongly marked in the group difference in the judgment of Botany cloths.

(D) Blind Women and Miscellaneous Touch Group

Six blind women found great difficulty in arranging the cloths, as their results indicate. Six persons with normal sight and with a known delicate sense of touch were tested by full judgment for comparison, and the agreements between the two groups are shown in Table XIV.

Table XIV.—Blind Women and Selected Touch Group

	Standards		
	Trade	"Wool"	Children
Six Blind Women	·05 ...	·05 ...	·16
Six Selected Persons	·50 ...	·29 ...	— ·07

None of the six selected persons was in the Woollen Trade Group, but the handling of materials as a dress-fitter, dyer, tailor, or manufacturer brought them nearer the technical groups. The blind women, on the contrary, show no effective agreement with either standard, having this feature in common with the two groups of teachers and the technical analysts. In these cases the intelligence factor was not the decisive one, as all were of high attainments, but the active co-operation in their daily life of the mind-sense faculty is either not possible or circumstances offer no opportunity for its use.

FUNDAMENTAL AGREEMENTS BETWEEN GROUPS

With a view to defining more closely the relationship of the various trained and untrained groups with the Trade and the Children's Standards, the results of 22 main groups have been correlated. The physical standards obtained by mechanical appliances for wool, weight, thickness, and threads, form a series of definitely-fixed measures. The Trade takes these standards to account in estimating value which it largely bases on production costs. The Children's group relies almost entirely upon superficial and sensory factors. Another group might be isolated as individuals with restricted judgments in which sight or touch work independently. Non-trade adults, again, have not had the co-ordinated training of the Traders and yet have a mentality much above that of the children.

In Table XV. the agreements or disagreements are placed in their order of magnitude, those being most in accord with the other 21 Groups being at the head of the columns, with those most in disagreement at the bottom.

It will at once be seen, in Column A, that the children's groups are, with the single exception of the Defective girls, at the top of the list. At the bottom are the Trade judges, interspersed with the physical standards on which judgments of costs are formed. Between the two sets lie the restricted judgments. The exceptions to these broad divisions are the Dyers, who are quite away from their right place in the Trade groups and are included within the children's ranking. This is a known characteristic of Dyers under

Table XV.

	A Average Corre-lation Coefficient	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	B Calculated Ranking	C Defectives to Experts Estimated Ranking
1 Mentally Defective Boys ...	·42	—	·80	·60	·92	·89	·85	·89	·35	·74	·21	·50	·58	·35	·01	·13	·09	·19	·10	·09	·02	·34	·37	1	2
2 Secondary Girls...	·42	·80	—	·54	·86	·85	·90	·84	·59	·60	·18	·50	·55	·39	·18	·13	·03	−·01	·10	·21	−·15	·36	·53	2	5
3 Dyers	·41	·60	·54	—	·41	·36	·45	·60	·52	·43	·67	·44	·43	·52	·68	·41	·42	·51	·49	·22	·26	−·06	−·17	3	11
4 Elementary Boys	·38	·92	·86	·41	—	·94	·91	·92	·41	·62	·17	·42	·50	·37	−·10	·02	·15	·04	·03	−·06	−·12	·32	·40	4	4
5 Elementary Girls	·37	·89	·85	·36	·94	—	·95	·90	·47	·65	·10	·35	·49	·35	−·05	·02	·00	−·02	−·07	·02	−·28	·36	·48	5	3
6 Children's Standard	·36	·85	·90	·45	·91	·95	—	·94	·40	·59	·10	·35	·46	·39	·04	·02	−·12	−·16	·00	−·06	−·28	·43	·48	6x	7
7 Secondary Boys	·36	·89	·84	·60	·92	·90	·94	—	·41	·55	·17	·30	·46	·32	·03	−·01	−·02	−·03	·00	−·21	−·21	·32	·48	6x	6
8 Non-trade Men	·35	·35	·59	·52	·41	·47	·40	·41	—	·41	·76	·58	·45	·19	·34	·29	·41	·31	·36	·07	−·06	−·02	·15	8	10
9 Thickness	·34	·74	·60	·43	·62	·65	·59	·55	·41	—	·30	·54	·36	·57	·16	−·09	−·20	·14	·00	−·18	−·09	·52	·59	—	—
10 Experimenter (touch only) ...	·32	·31	·18	·67	·17	·10	·10	·17	·76	·30	—	·78	·34	·30	·71	·41	·59	·58	·57	·20	·31	−·34	−·29	9	13
11 12 Traders (sight only) ...	·31	·50	·50	·44	·42	·35	·35	·30	·58	·54	·78	—	·34	·33	·05	·41	·27	·48	·09	·15	·08	−·28	−·05	—	—
12 Blind Women	·29	·58	·55	·43	·50	·49	·46	·48	·45	·36	·34	·34	—	·17	·05	·22	·08	·33	·18	·14	−·11	−·02	·23	10	8
13 Mentally Defective Girls ...	·27	·35	·39	·52	·37	·35	·39	·32	·19	·57	·30	·33	·17	—	·33	·07	·14	·25	·04	·14	·07	·19	·32	11	1
14 Non-trade Women	·24	·01	·18	·68	−·10	−·05	·04	·03	·34	·16	·71	·05	·03	·33	—	·73	·65	·47	·45	·56	·58	−·40	−·41	12	9
15 Worsted Group	·20	·13	·13	·41	·02	·02	·02	−·01	·29	−·09	·41	·41	·22	·07	·73	—	·86	·27	·52	·55	·60	−·70	−·62	13	12
16 Woollen Group	·19	·09	·03	·42	·15	·00	−·12	−·02	·41	−·20	·59	·27	·08	·14	·65	·86	—	·23	·71	·46	·79	−·70	−·70	14	14
17 12 Traders (touch only) ...	·19	·19	−·01	·51	·04	−·02	−·16	−·03	·31	·14	·58	·48	·33	·25	·47	·27	·23	—	·32	·16	·49	−·19	−·33	—	—
18 Flannel Buyers	·17	·10	·10	·49	·03	−·07	·00	−·00	·36	·00	·57	·09	·18	·04	·45	·52	·71	·32	—	·26	·52	−·39	−·54	15	15
19 Wool Percentage	·11	·09	·21	·22	−·06	·02	−·06	−·21	·07	−·18	·20	·15	·14	·14	·56	·55	·46	·16	·26	—	·48	−·51	−·38	—	—
20 Flannel Manufacturers	·08	·02	−·15	·26	−·12	−·28	−·28	−·21	−·06	−·09	·31	·08	−·11	·07	·58	·60	·79	·49	·52	·48	—	−·70	−·50	16	16
21 Threads per inch	·04	·34	·36	−·06	·32	·36	·43	·32	−·02	·52	−·34	−·28	−·02	·19	−·40	−·70	−·70	−·19	−·39	−·51	·70	—	·60	—	—
22 Weight per yard	·03	·37	·53	−·17	·40	·48	·48	·48	·15	·59	−·29	−·05	·23	·32	−·41	−·62	−·70	−·33	−·54	−·38	−·50	·60	—	—	—
Average	·27																							+·80 ± ·191	

experimental conditions, because their duty is to appeal by the senses of sight and touch to the emotional rather than the reasoning and constructive aspect of a production. Thickness is apparently out of its Trade position, but in reality this factor is ignored by the Trade as it can be easily altered by pressing, after finishing, one way or another. Mentally Defective girls are apparently out of position, but the writer would prefer the explanation that this is their proper place. Defectives have a restricted judgment by mind—the other groups were restricted by sense or by lack of trained co-operation between the mind and the senses. It has been previously shown, and this is confirmed by other inquiries that the special type of handwork given to these defective boys has a good effect in relationship to the subject now under consideration. These boys varied from very good to very bad cases but the general effect appears to have been so good that the co-operation of mind and sight with a more highly developed touch has given them a very decided bias in the sensory groups and placed them on the same level as Secondary School girls. It is curious to note that both the Defective boys and girls are the only two groups which record no disagreements with any of the other groups, even though they occupy first and thirteenth places in the group ranking.

Another method of interpreting the meaning of the various rankings of the groups is to accept the order stated in Column B and compare it with Column C, which represents approximately the probable ranking of children in school, the non-trade adults and finally the worsted and woollen traders. The two columns are obviously closely related and show a high agreement at plus $\cdot 80 \pm \cdot 191$. This seems to indicate that there is a progressive improvement through various stages from the most co-ordinated faculties on a purely sensory level to a most complex co-ordination of the faculties on a trained technical level. The division between the two tendencies lies nearest the point of restricted faculties either of the mind or of the senses; or occurs when one faculty is developed at the expense of the others. Thus a non-trade woman may by delicate needlework or similar means, unconsciously develop a good mind-sense co-ordination. In addition, the washing of fabrics may give her a more or less trained judgment and her bias is then towards the trade opinion. Another, such as a teacher, may have the tactile faculty restricted by circumstances beyond her control, causing lack of co-ordination, and her place in the ranking remains neutral. Or a man following a professional career, in which little use is made of the sense of touch, may highly develop his visual sense; he may find pleasure in some hobby which corrects this bias, and thus drifts his judgment towards the Children's Standard. A technical experimenter who places entire reliance on mechanical appliances may find his full judgment atrophied in course of time. A highly trained person may, in consequence, have restricted judgment because of this lack of tactile co-ordination and thus fall into the neutral zone which may be a near approach to "pure chance" judgment.

It is unnecessary to go into details of Table XV. to any extent, but consideration of a few of the chief agreements may serve a useful purpose. The Children's Standard (No. 6) is seen to vary only to a minute degree with the normal children's groups, the Mentally Defective girls being excepted; similarly, there is a stability from one group to another which one could not have suspected and which has surprised the experimenter. The Trade groups are also, in the main, compact, showing that the same factors in judgment are present; Dyers are the exception. Dyers have the

highest correlations with the Experimenter's touch (·67) and the non-trade women (·68) suggesting a common view-point, though there are wide differences in training. The non-trade men are also well correlated with the Experimenter's touch (·76) but only to a small extent with the women (·34). The Experimenter's Touch is closely agreed with the sight judgments of 12 traders (·78) and the women (·71); the Trade Standard ·59, the touch judgments of 12 traders ·58, and Flannel Buyers ·57, showing very little connection with the judgment of children. The Blind Touch judgment agreed, on the contrary, with the different children's groups, as might be anticipated. The Trade Standard was obtained from the Woollen groups only, but the Worsted groups are correlated with it very highly at ·86; with Flannel Manufacturers at ·79 and Flannel Buyers at ·71.

It must be surprising to any person who has had experience in the type of cloths tested to find such definite standards of judgment. When it is realised that the samples were originally selected for persons experienced in the flannel trade, the figures recorded by the children must excite astonishment and thought. Agreement in correlations not only occurs in their mass judgments but in the details of each group, and is more solid than the inter-agreements of the various trade sections, which might have been expected to give higher correlations with each other than would those of the children. The indications are that there is a natural mind-sense judgment which is uniform and wide-spread amongst children of different training. Certain kinds of handwork appear to afford the means of developing this natural judgment by cultivating a finer appreciation of smaller differences in the superficial factors of judgment.

A trade judgment is definitely acquired by means of knowledge and experience; it brings the reasoning faculties to bear in the analysis of intricate problems of production or distribution. The same mind-sense organs are needed as in the case of the children, but this trained judgment demands higher mental powers for the better interpretation of the more complex and numerous factors presented for judgment.

Both natural and trained trade judgments require the active co-operation of the mental and sensory faculties, and it is desirable in consequence that the former be developed as the foundation of the latter. It is essential that the various mental and bodily activities should be well balanced or a restricted judgment will occur in either of the different judgments. The absence of mental capacity or the reduction in the powers of the senses of sight or touch especially tends to unbalance the judgment in proportion to the loss of ability and the extent of the inco-ordination. Similarly, the balance of the mind-sense organs by training is necessary if they are expected to work in harmony—a definite bias to the mind, the sight, the touch, or any other factor must of necessity tend to decrease the balance of the whole.

Professor C. Spearman, in his Presidential Address to the Psychology Section of the British Association for the Advancement of Science at Southampton, 1925, in "Some Issues in the Theory of '*g*' " said that "the measure of every different ability of any person can be resolved into two factors, of which the one is always the same, but the other always independent. The fixed factor '*g*' measured something in the nature of an 'energy' derived from the whole cortex or wider area of the brain. The independent factors (*s*), which are numerous, measure the respective efficiencies of the different parts of the brain in which this energy can be concentrated; they are, so to speak, its 'engines.' Whenever the mind turns from one operation to

another, its energy is switched off from one engine to another, much as the power supply of a factory can be directed at one moment to turning a wheel at the next to heating a furnace, and then to blowing a whistle." Spearman proceeds to say "that the relative influence of the energy and the engines changes largely with the class of person at issue. The most drastic instance of this is supplied by a comparison between normal children and those who are mentally defective." The work of Abelson is then quoted where the same tests were applied by the same experimenter to both classes, the mean of the 78 normal children being ·466, and that of the 22 defective children ·782. The correlations are much smaller in the case of the normal children. This indicates that with these the influence of the energy has gone down and that of the engines has correspondingly gone up. Professors Burt, Otis, and Carothers, have found the same characteristics.

It is an interesting fact that there is not a single negative correlation between the two mentally defective groups and the remaining twenty groups. On the other hand, it seems equally significant that technical considerations form but a tiny part of the judgments of the groups. Weight, threads, wool, &c., all play a small part, whilst thickness is relatively important. Flannel manufacturers have little in common with the other groups.

The tendency confirms the statement of Professor Spearman, "The correlations always become smaller—showing the influence of '*g*' to grow less in just the classes of person which on the whole possess this '*g*' more abundantly." Commercially, it might be interpreted that technically trained specialists in the many sections of the trade tend to disagree amongst themselves in proportion to the intricacy of their knowledge and the value of their experience. The nearer people are to the primitive state, the more do they tend to agree with each other in their judgments. The trade is always attempting to reconcile these different points of view by trial and error methods; the scientific outlook is to reconcile the two by refined measurement.

DEGREE OF RELIABILITY OF THE SENSE OF TOUCH WHEN APPLIED TO FLANNELS

With a view to ascertaining how far judgments, made in some cases partially, and in some cases entirely by touch, were to be relied upon, the experimenter carried out a series of tests on 10 samples chosen from ranges A, B, and C, which were similar in type but varied in wool content. This subsidiary investigation proceeded upon lines parallel to those of a previous investigation* and is noted here only in so far as the conclusions drawn from it may be applied to the main investigation described in this paper.

It was proved that the Experimenter's experience had a distinct effect upon these "touch" judgments but that percentage wool content was not the main factor influencing judgments. Fine finish in one case particularly, outweighed other factors. The complexity of factors playing each their part in the make-up of the fabrics made the isolation of any one as being decisive, well-nigh impossible. After a series of such tests carried out continuously it is necessary to record that progression in accuracy of judgment though marked at first, a correlation of ·72 was recorded in the first 60 trials, in the second 60 trials was much retarded, the correlation falling to ·13.

*"A Comparison of Visual and Tactile Judgment in Individuals of Different Ages and Training." Paper read at VIIth International Congress of Psychology by H. Binns and Professor H. S. Raper.

Changing the method to that of making a few similar trials (6 per day) over a series of days, it was found that short practice gave a very similar result, viz.—cumulative improvement for a time, followed by a much slower progress due, probably, to having reached a higher level of efficiency. Weather was proved to be a disturbing factor which may be explained probably by its effect on the moisture content of the fabrics; this affected the touch or "feel" and so modified judgments. It can be recorded also that "mind wandering" definitely makes for erratic results and that "cocksureness" does not by any means coincide with accuracy.

TYPICAL INDIVIDUAL DIFFERENCES IN JUDGMENTS

It was the writer's first intention to include a number of instances of typical individual differences in judgment among the judges whose mass and group judgments have been described. On second thoughts it has been decided not to overburden this paper with additional data; which, however interesting in themselves, only serve to emphasise points already, it is hoped, made quite clear. Some of these individuals had a definite bias towards the "Natural" or children's judgment, while others had a definite, though only partial, "trade" bias in their judgments. Either "finish" or "softness of wool" seem to have swayed those judgments exhibiting a definite decision, whereas the judgments of those individuals whose neglect of the sensory faculties had resulted in lack of balance in the brain faculties generally were notably lacking in decision and their judgments were obviously those of "pure chance." "Samples" used as evidence of characteristics which cannot be described either verbally or in writing would seem to be an absolute essential of the wool trade, since the proper co-ordination of the faculties of the mind with those of the senses affords a means of estimating with remarkable accuracy just those characteristics.

CONCLUSIONS

These have been definitely incorporated in each successive section of the paper as they seemed best stated in this way. Those now drawn are generally applicable to the whole investigation. By an examination of the mass judgments of the adult judges, whether "trade" or "non-trade," and of the normal children it has been determined that two distinct "standards" of types of judgment exist. That of the "trade" is based upon an appreciation, due to special and intensive training, of the many technical factors in a cloth construction. The "Natural" judgment or that of the "children" is based upon those superficial and sensory factors which are in immediate and direct liason with the senses of touch and sight. Large percentages of wool, special soft water and "wool" finishes, and such factors reacted to these "standards" in a way that emphasised the "technical" knowledge of the "trade" judges and the "sensory" bias of the "children's" judgments. Though it has to be recorded that special tests by the experimenter upon himself, demonstrate that the wool-content alone is not always the deciding factor even in making a "trained" or "experienced" judgment. "Softness of finish" does much to mystify even a trained man, especially when associated with variations in weight and thickness of cloth. Further analysis of these mass-judgment standards by correlations of group judgments gave additional evidence as to their character. The various groups of adult judges exhibited correlations more and more nearly in accord with the trade standard as their technical training and experience increased, but those whose profession or occupation did not demand the use of the mind sense faculties or whose technical

work was of a mechanical-analysis character disagreed with the "trade" standard, though such a disagreement did not necessarily imply agreement with the "children's" standard. Comparison, on the other hand, of normal children's judgment with that of defective boys and girls revealed a gradation of judgment, here also influenced by the degree of co-ordination between intellectual and sensory faculties or by the absence of one or the other. Of special note is the influence of training upon defective boys, since their tailoring work seems definitely to have improved their grading well-nigh to that of normal children. Defective girls exhibited no such phenomenon. At times a positive agreement has been revealed between the children's and the trade judgment; at other times a positive disagreement is shown. Though in the tests under discussion these differences are explainable, the intricate causes of these differences suggest other problems of importance. The writer is of opinion that tests indicating that the development of intelligence ceases at about 13 to 15 years of age may coincide with the positive agreements between these skilled adults and children. If, however, other tests were applied on the same individuals it might possibly be shown that a slight variation of the test material gave opposite results. It seems obvious that whilst there is a common factor of judgment graded from imbecility to the most delicate trade judgment, there is also a sharp twist between the untrained and the trained judgments which, if disregarded, may lead to wrong conclusions. There has been revealed no real connection at any point between the children's judgment and the trade judgment. In considering the children's judgments there appears to be no sex difference measurable, but handwork in either sex gave stronger decisions. General intellectual sharpness definitely in one group more than counterbalanced six years age advantage in another. Of the individual judgments it is to be recorded that neither continuous practice nor short, regular practice gave steady improvement beyond a certain point or standard of efficiency. Weather conditions had a definite effect, in all probability through their effect on "condition" and thus directly upon "feel" or the touch sense. A "wandering" mind made for erratic judgment while "cocksureness" did not necessarily imply accuracy.

My warm thanks are extended to the members of the Bradford Textile Society who assisted in the tests; to the chief officers of the Bradford Education Committee, Miss S. E. Mitchell, M.A., Mr. William Macpherson, M.A., Mr. G. H. Pickford, B.A.; to Mr. W. H. Meggs, F.S.A.M., and other Headmasters and Headmistresses for their willing help; also to Professor Cyril Burt, D.Sc., M.A., for his advice on psychological and statistical methods.

57—A UNIVERSAL METHOD FOR CONVERTING FIBROIN,* CHITIN, CASEIN, AND SIMILAR SUBSTANCES INTO THE ROPY-PLASTIC STATE, AND INTO THE STATE OF COLLOIDAL SOLUTION BY MEANS OF CONCENTRATED AQUEOUS SOLUTIONS OF READILY SOLUBLE SALTS, CAPABLE OF STRONG HYDRATION

By P. P. von Weimarn

As far back as 1912 the writer had established[1] the fact that aqueous solutions of any readily soluble salt, capable of strong hydration, are able to convert cellulose into the plastic state, as well as to effect the colloidal dissolution of cellulose. The concentration of the solution, the temperature at which the dispersion of cellulose proceeds, also the time interval necessary to complete the dispersion process vary, of course, in accordance with the nature of the salt taken, its solubility, and its degree of hydration. If by the ability of salts to produce dispersion (designated by the symbol D), we understand magnitudes directly dependent on the average rates of dispersion of the same kind of cellulose (the other experimental conditions being, of course, the same), then the following progressions[2] would be both theoretically and experimentally established, *e.g.*, for certain lithium and calcium salts—

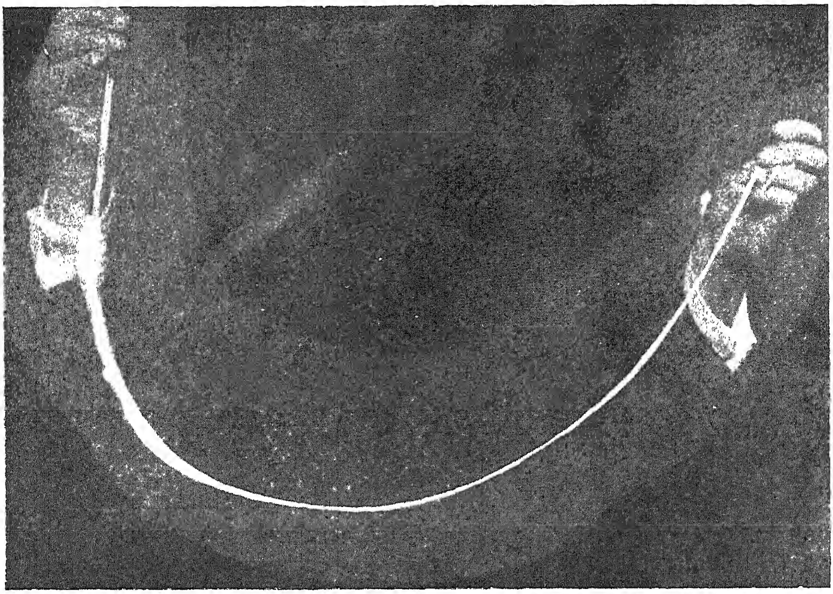
$$D_{LiI} > D_{LiCNS} > D_{LiBr};\ D_{Ca(CNS)_2} > D_{CaI_2} > D_{CaBr_2}.$$

These six salts are examples of salts with high dispersing powers.

In 1913, the author announced definitely that aqueous salt solutions are theoretically able to disperse not only cellulose but also other dispersoids capable of hydrolysis to soluble products—"*The above theory may be generalised for any dispersoid which yields soluble compounds through hydrolysis.*"[3] In other words, such organic colloids as fibroin (the chief constituent of natural silk), chitin (containing nitrogenous polysaccharide, *i.e.* the nearest analogue to cellulose, and being the chief constituent part of the shells of cuttlefish (sepia), crayfish, crabs, lobsters, beetles, &c.), and similar colloids, are also convertible by means of concentrated aqueous salt solutions into the ropy-plastic state and into colloidal solutions. The experimental proof of this theoretical deduction could be realised by the author only in the middle of December 1925, with fibroin, and in collaboration with S. Utzino† at the beginning of the year 1926 (February-March), with chitin, casein, fibrin, and keratin. Fibroin, in the form of silk wadding, proved to be

* Application for Letters Patent on this method has been made in the Japanese Empire. *Patentee*—The Imperial Industrial Research Institute of Osaka. *Inventor*—Professor P. P. von Weimarn. *Date of Invention*—December 1925. The application for the Patent was the cause of my delaying for several months the publication of the results obtained by me.

† In the Laboratory of Physical Chemistry (Director-Professor Y. Osaka) of the Imperial University of Kioto, Dr. S. Utzino is now submitting to a special study the hydrolytic action (compare P. P. von Weimarn, Annals of the S. Petersburg Mining Institute, 1913, **4**, 151) of concentrated aqueous solutions of neutral salts upon the substances mentioned above.



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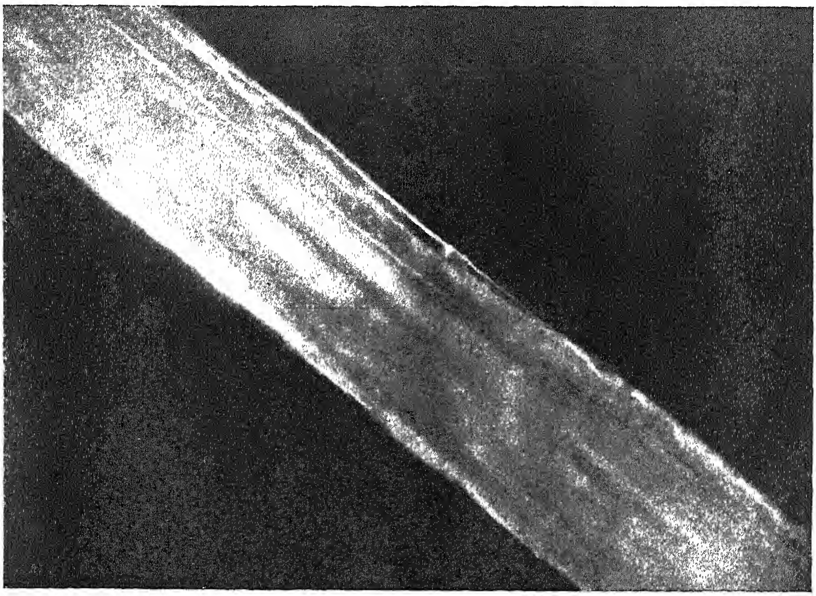

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much more ready to undergo colloidal dispersion in aqueous salt solutions than cellulose; for instance, lithium thiocyanate solutions produce colloidal dissolution of silk wadding at room temperature (*e.g.*, at 25° C.), and—what is of special practical importance—as much as 10 grams of silk wadding may be dissolved at 5–10 minutes in 100 c.c. of neutral aqueous solutions of such common and cheap salts as calcium chloride or nitrate at their boiling temperatures, 115° C. The preparation of 30% colloidal solutions of silk in the solutions of these salts is quite practicable.

Fibroin may be separated from these colloidal solutions in a perfect ropy-plastic state by means of various dehydrating and coagulating substances and agents (also by ultrafiltration and centrifuging). Of utmost interest is the formation of a filamentous coagulum by means of ethyl alcohol. For example, to a 10% colloidal solution of fibroin in aqueous calcium nitrate solution, cooled from 115° C. to 50–25° C., ethyl alcohol at the ordinary temperature 25°–20° C. is added, while constantly stirring the contents with a glass rod. A filamentous precipitate of fibroin is formed, which will wind round the glass rod like a reel. The ropy-plasticity of this precipitate permits it to be greatly extended, as seen in photograph A. In photomicrograph B (dark ground illumination) is represented a thin thread of such a precipitate (magnification about 200); as can be observed from the photomicrograph, the thread represents the combination of many almost parallel filaments. I shall not here go into details; I wish only to point out that the dispersing powers of salts for fibroin are connected by a similar series of progressions as exists for cellulose; for instance—

$$D_{\mathrm{LiI}} > D_{\mathrm{LiCNS}} > D_{\mathrm{LiBr}} > D_{\mathrm{LiCl}},\ D_{\mathrm{Ca(CNS)_2}} > D_{\mathrm{CaI_2}} > D_{\mathrm{CaBr_2}} > D_{\mathrm{CaCl_2}}$$

&c. In collaboration with my pupil, S. Utzino, we succeeded in establishing the fact that chitin (prepared from the internal shell of sepia, or from a Japanese kind of lobster, "kuruma-ebi") is also convertible into the plastic state, as well as into the state of colloidal solution by means of aqueous salt solutions (as might have been expected, *a priori*, of course, since chitin, like cellulose, is a polysaccharide, only containing nitrogen in addition). The order of dispersing powers for chitin is similar to that for cellulose; for example—

$$D_{\mathrm{LiCNS}} > D_{\mathrm{Ca(CNS)_2}} > D_{\mathrm{CaI_2}} > D_{\mathrm{CaBr_2}} > D_{\mathrm{CaCl_2}}.$$

In calcium chloride solutions, chitin disperses with difficulty. The properties of colloidal solutions of chitin in salt solutions approach in some respects those of cellulose; but the gelatinous precipitates and jellies obtained by the addition of ethyl alcohol are perfectly translucent for chitin (*e.g.*, from LiCNS-solution), but almost opaque for cellulose. With casein, it was observed that although calcium chloride solution will convert casein into the ropy-plastic state, it fails (under ordinary pressure) to produce colloidal dissolution, at least to an appreciable extent Calcium thiocyanate, iodide, or bromide solutions, however, effect a marked colloidal dissolution of casein. Casein is most easily dispersed in lithium thiocyanate solutions. Even in the cold it may go spontaneously into colloidal solution, and at 25° C. the dissolution is easy. The dispersion of fibrin and keratin in salt solutions is more difficult than in the case of cellulose or of chitin. However, extremely soluble salts (*e.g.*, lithium, and calcium thiocyanates), in strongly concentrated solutions, disperse these substances to a marked degree. For instance, keratin (in the form of pure white woollen yarn), in extremely

concentrated lithium thiocyanate solutions (between 170°–200° C.), after swelling, rapidly assumes a translucent, jellied, plastic state, and on further heating passes into colloidal solution.

It is noteworthy that the rate of the dispersion process (colloidal dissolution) of all the above substances (cellulose, fibroin, chitin, casein, fibrin, and keratin) is dependent not only on the nature of a certain given salt, and the concentration and temperature of its solution, but also to a considerable extent upon the life history, age, and other antecedents, and upon the degree of purity of the preparations taken for experimentation. I should like merely to point out briefly, not dealing exhaustively with the subject at this time, that, for instance, three preparations of chitin were used in our (P. P. von Weimarn and S. Utzino) experiments—Chitin from the internal shell of sepia (designated as chitin S); chitin from the shells of the Japanese kind of lobsters "Kuruma-ebi" (designated as chitin K); chitin from the Japanese kind of lobsters "Ise-ebi," of a considerably larger size and having a considerably thicker and compacter shell than the former ones (designated as chitin I). These all gave the following inequalities for "*D*"—

$$D_{\text{chitin S}} > D_{\text{chitin K}} > D_{\text{chitin I}}$$

Chitin S disperses most easily and rapidly into the colloidal solution, while chitin I is dispersed slowly with the utmost difficulty into the same condition. This difference is due not only to the life history, age, and other antecedents of the preparations of chitin experimented upon, but also to the different degrees of the purification of chitin from its inorganic part. In the case of chitin I, this elimination is accomplished with the most difficulty. All our experiments on the dispersion of cellulose, fibroin, chitin, casein, fibrin, and keratin, by means of concentrated aqueous solutions of readily soluble salts bring us to the conclusion that the same range of dispersing powers holds for all the substances mentioned above; thus—

$$D_{\text{LiI}} > D_{\text{LiCNS}} > D_{\text{LiBr}} > D_{\text{LiCl}};\ D_{\text{NaCNS}} > D_{\text{NaI}};\ D_{\text{Ca(CNS)}_2} > D_{\text{CaI}_2} > D_{\text{CaBr}_2} > D_{\text{CaCl}_2}$$

&c. Therefore, it would be possible to dissolve colloidally either cellulose together with fibroin, or cellulose, chitin and fibroin simultaneously, in aqueous solutions of some extremely soluble salt, such as sodium-iodide, lithium bromide, lithium thiocyanate, or calcium thiocyanate solutions, And from these colloidal solutions complex plastic masses may be obtained, as, for instance, x cellulose $+ y$ fibroin; x cellulose $+ y$ chitin $+ z$ fibroin, &c. Hence it is my firm conviction that the scientific and technical study of the properties of such complex plastic masses, and filaments produced from them, is of great interest, not only from the point of view of the colloidal theory of dispersion, but because it opens a wide horizon for the artificial filaments industry.

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[2] P. P. von Weimarn. On the character of these several series of inequalities, see J. Chem. Education, 1926, **3**, 378–379.

[3] P. P. von Weimarn. Annals of the S. Petersburg Mining Institute, 1913, **4**, 151. A German translation appeared in Kolloid Z., 1921, **29**, 198, and a translation into English was published in the Reports of the Imperial Industrial Res. Institute of Osaka, 1923, **4**, No. 7, p. 22.

58.—THE EFFECT OF HUMIDITY ON COTTON YARN

THE STRENGTH AND EXTENSIBILITY OF SIZED AND UNSIZED WARP YARNS IN EQUILIBRIUM WITH STEADY ATMOSPHERIC CONDITIONS

By Frederick Thomas Peirce, B.Sc., F.Inst.P., and
Reginald Joseph Stephenson, B.Sc., A.Inst.P.

(British Cotton Industry Research Association)

INTRODUCTION AND SUMMARY

The nature and extent of the well-recognised influence of atmospheric humidity on the properties of cotton yarn are of direct interest in three connections, namely, its effect as a condition of (*a*) spinning, on the yarn produced, (*b*) testing, on the numerical result, and (*c*) weaving, on the loom breakages. In the present paper, the first problem is not explicitly considered, the second is elucidated as the data were obtained by testing, but the experiments were devised to throw as much light as possible on the third question. Breaks in a loom are due to many co-operating factors which complicate observations in the shed, and mechanical testing of the warp is one of the simplest, though not a self-sufficient, means of control.

In an earlier Memoir,[13] data published before 1923 on question (*b*) have been summarised, and it is evident that there is not sufficient information to apply corrections for humidity nor to relate the effect to the structure of the yarn or the properties of cotton. A systematic piece of work has since been done under controlled conditions on tyre cord by Fuwa,[4] the behaviour of which is compared with that of unsized single yarn in this paper. Some results obtained by Turner[12] are also used.

The yarns tested in the present work were a set of warp yarns, spun to a twist factor about 3·8, four about 33's count, one 50's count, two being also pure sized and two heavy sized (details in Table II.). These yarns, representative of common trade products and spanning a wide range of quality, were tested at humidities from dryness to saturation by the methods described in previous Memoirs,[9,10] namely, for single-thread breaking load and extension, and for ballistic work of rupture.

The humidity and temperature of the testing room were controlled by a plant which saturates the incoming stream of air at a fixed temperature (the dew point) and heats it to maintain the room at a higher fixed temperature. Humidified boxes were also used to condition the specimens beforehand and ensure that the results correspond to the equilibrium state of the yarn in the given atmosphere.

It is sometimes stated that the effect of humidity is irregular, to test which point it was first studied on a very regular combed Sakel yarn from bobbins spun consecutively on one spindle. A number of independent tests

were carried out on "cut-skein"[9] samples, and the slopes between each pair of the plotted points show a regularity which proves that the effect is consistent and the conditions reproducible. The differences between independent tests on yarn from the same spindle and the greater differences between the products of the two spindles explain any apparent inconsistency when tests are made on independent samples.

Both strength (breaking load) and extension were found to increase steadily with humidity from 30 to 80 R.H. (percentage relative humidity). The breaking load attained its maximum about 87 R.H. and did not increase further, even on soaking. The increase in extension also becomes very slow or inappreciable at very high humidities. Confirmation of these changes is given by the breaking load in the quicker Moscrop test and by the ballistic work of rupture. Tests on the bone-dry yarn can be performed most easily by the last, most rapid method, and they show that the rate of change is greater at low humidities. These relations are fully in accord with the effect on the breaking load of tyre cords as found by Fuwa.[4]

Series of tests carried out on the four other unsized warp yarns gave generally similar results. The humidity at which the breaking load attains its maximum varies, however, from 70 to 100 R.H. for reasons not immediately apparent in the quality or structure of the several yarns. The steady slope below this humidity also varies from yarn to yarn, but its mean value has general significance as it is practically the same as that found by Fuwa[4] for tyre cords, by Barwick[2] for drill, and by Barr[1] for cotton fabric. Taking the strength at 70 R.H. as the standard, a rise of 10 R.H. produces a rise of 3·7%. Technically this effect is small in comparison with those of twist, count, quality of cotton, or combing. As a testing correction it seems a generally useful approximation over the normal range of humidities.

The change in extension is more considerable and probably of more technical importance. The mean value is a 7·1% increase for a rise of 10 R.H., a considerable effect in comparison with variations due to other factors, such as twist, staple, and counts. The limiting extension falls more rapidly with loss of moisture in the yarns of short staple. Above 85 R.H. the increase is negligibly small; below 30 R.H. the rate of change also appears to be less than over the intermediate range.

No improvement in expression is obtained by plotting the strength against moisture regain. Nor is it legitimate to assume that the variation of strength is determined necessarily by the regain and that the effect of atmospheric conditions is reproduced by drying to varying regains and testing at constant humidity. The corrections given by Haven[5] and tentatively adopted by the American Society for Testing Materials appear to be based on this very dubious assumption. Actually the strength is not a truly unique function of either humidity or regain, but depends to a certain extent on the history. If it be desired to correct test results from regain determinations, the above correction is roughly equivalent to 2·6% of the strength at 8 M.R. (percentage moisture regain) for a change of 1 M.R.

Sized yarn is affected by humidity in quite a different way from the unsized material. The strength is at a maximum between 70 and 80 R.H., weakening very slightly on the dry side, by about 4% to the bone-dry state, and dropping more rapidly above 80 R.H. by 10% to the wet state. The small variations at lower humidities are not uniform, but the chance resultants of the loss of cotton strength and the rise of starch strength. The drop

above 80 R.H. is uniform and represents the rapid loss of rigidity of the starch over a region where the cotton maintains a constant strength.

On the other hand, the limiting extension is extremely sensitive to humidity, increasingly so as the atmosphere becomes more humid. From bone-dry to wet, the percentage extension increases on the average from $2\frac{1}{2}$ to 7, and by 0·9 for a rise of 10 R.H. in the region about 70 R.H. The heavily sized yarns are distinctly more sensitive to humidity than the pure sized. The changes in work of rupture fully support and confirm the results obtained on the single-thread tester, both as to the form of the relation and the relative sensitivity of the several yarns.

All the relations are shown individually in Figs. 2–4. Their bearing on the general problem is seen more clearly by considering separately the extent of the change and the form of the relation. The former is expressed by a simple number measuring the relative sensitivity to humidity of each of the several properties of the four yarns and given in Table VIII. After eliminating the variations in magnitude of the changes, the relations are sufficiently similar in form to be superposed and expressed by one curve for each quantity as shown in Figs. 5 and 6. These, with Table VIII., give a concise summary of the complete results.

Considering these data as a whole and in relation to the known properties of cotton and starch, a great deal of light is thrown on the nature of the influence of humidity and of sizing on the yarn properties. In unsized yarns of medium twist at moderate humidities, excessive tension pulls some of the hairs loose, the remainder being ruptured when the yarn breaks. At higher humidities, more of the hairs are effectively gripped, and it can be plainly seen under magnification that the break of a moist yarn is more of a snap, and that of a dry one more of a pull-out. Humidity increases the tensile strength of cotton to a certain extent[7] but only enough to account for a portion of the change in yarn strength, which is further increased by the more effective gripping of the hairs as they swell and soften. When the grip becomes complete the breaking load reaches its maximum and the break becomes almost a pure snap, as it is in a sized yarn at all humidities. The strength is then practically the same as that of a wet sized yarn.

Those yarns which when unsized are more strengthened by humidity also show the greater increase in strength on sizing. Both increases are due to effective gripping of the hairs and must depend (*a*) inversely on the effectiveness of the grip of dry hairs on one another, which varies with the clinging power, parallelisation, and twist, and (*b*) directly on the maximum proportion of the aggregate strength attainable, which varies with the fineness, uniformity, and parallelisation.

Though the size cements the hairs and maintains the yarn strength at low humidities, it greatly diminishes its extensibility. From the curves for load/strain (Fig. 6), the elastic behaviour of sized yarn appears to be determined by that of cotton hairs, modified by that of starch. In unsized yarns, the hairs extend less at lower humidities but slip more under a given tension, the two effects roughly compensating. The excess of extension in the unsized material is mainly slip, weak and inelastic, as is shown clearly by wear, oscillating, and autographic tests. There is no significant difference between the wet yarns, sized and unsized, in breaking load, extensibility, or work of rupture. Above 80 R.H. the starch rapidly loses its strength and also its resilience. In judging technical questions by numerical test results,

such differences of slip, plastic flow, and true elasticity need to be considered as well as the gross extension.

Provided the sizing is sufficiently effective to prevent the hairs from slipping—and this appears to be generally the case—the mechanical properties of the sized yarn are mainly determined by those of the cotton hairs. The size cannot modify these or their hygroscopic relations appreciably, and only a limited margin remains subject to the composition of the size or the method of sizing. In linen yarns[8] this margin appears to be vanishingly small, but in cotton yarns, composed of discrete fibres, it is large enough to be of practical importance. Differences up to 10% of breaking load and 30% of extension may be produced by the specific properties of the size. On the question of the need for humidity in weaving, the greatest advantage to be sought from methods of sizing is to lessen the brittleness of the size in dry atmospheres, the properties of the cotton being beyond effective control. Both the influence of the size and the sensitivity to humidity increase with weight of size and shortness of staple.

Measurements have been made on the effects of past history, but only to the extent of seeing that such effects cannot have an appreciable influence on the humidity relations obtained. A description of this work, and of that done on the effect of temperature, is reserved for fuller investigation, as these questions are of intrinsic technical importance.

In practice, control of the hygroscopic state of the warp is largely governed by the measurement of atmospheric conditions. A number of instruments on different principles were made or obtained in connection with the present work to test their suitability for the several purposes of continuous and routine measurements, or for checking and calibrating more rapid instruments. A note on this subject is appended. The humidities quoted in this paper were measured by a ventilated wet and dry bulb hygrometer, whereas in weaving sheds the unventilated type is almost universal. Simplicity is the main advantage of the latter, as its results are less consistent, especially at low humidities.

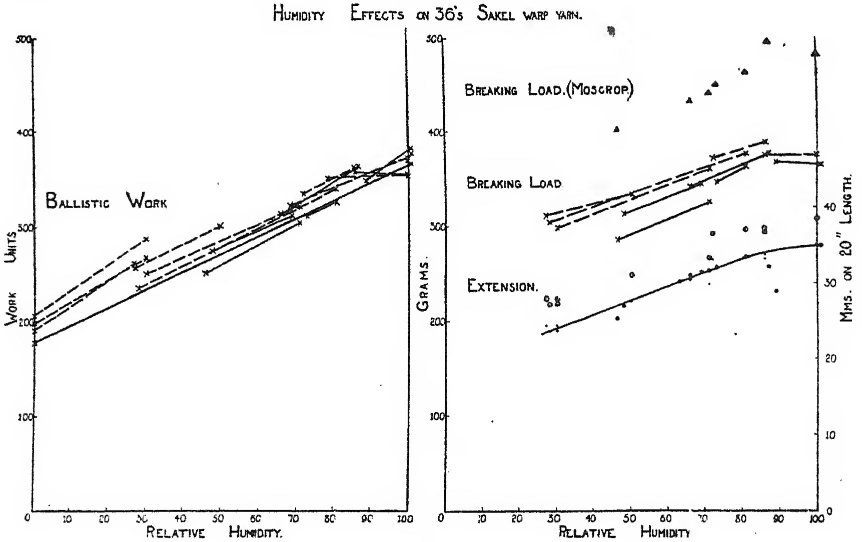
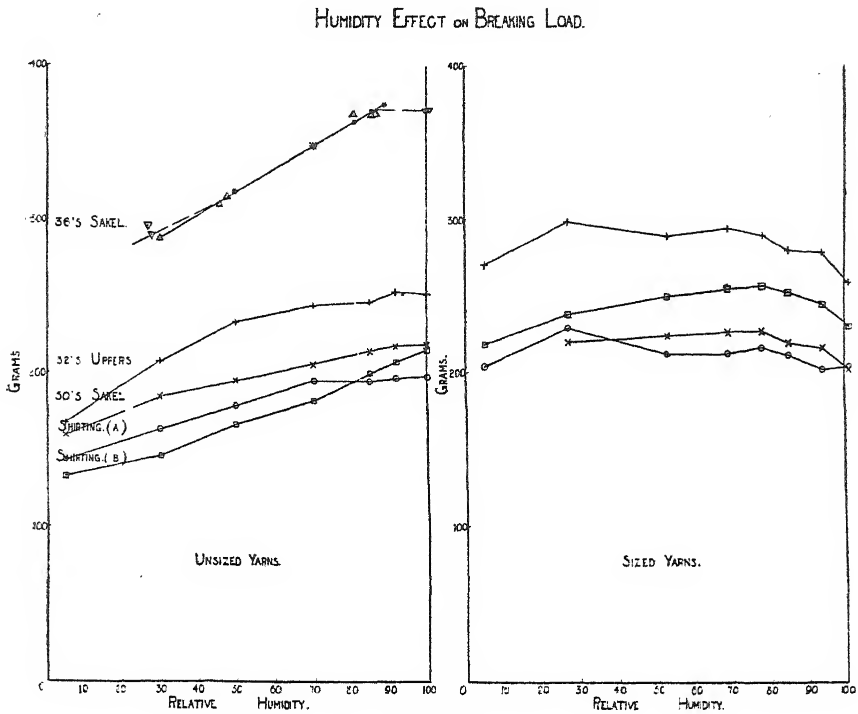
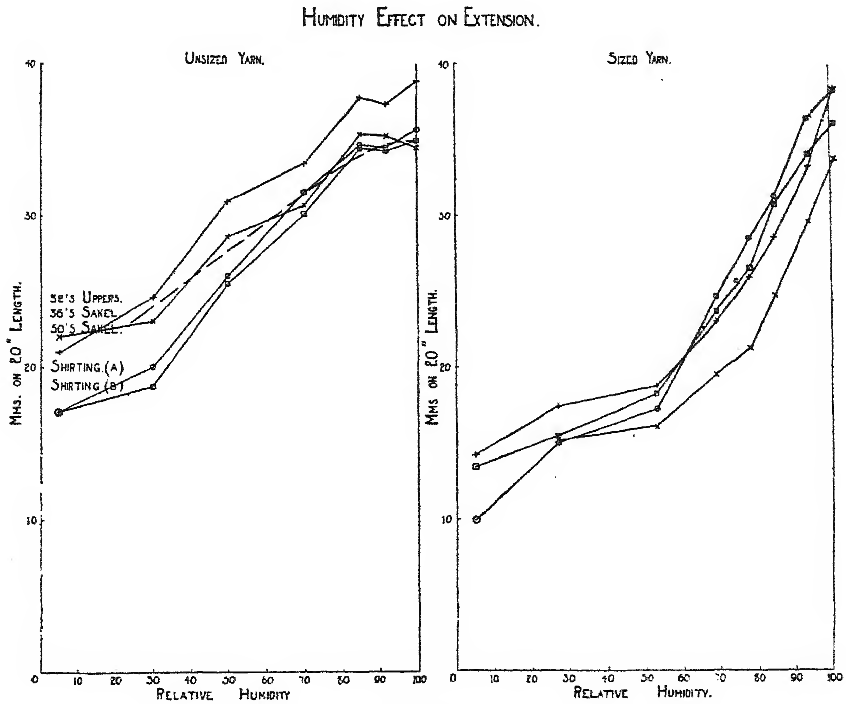


FIG. 1



HUMIDITY EFFECT ON BREAKING LOAD.
36'S SAKEL.
32'S UPPERS
50'S SAKEL
SHIRTING.(A)
SHIRTING.(B)
GRAMS
UNSIZED YARNS.
SIZED YARNS.
GRAMS.
RELATIVE HUMIDITY.

FIG. 2



HUMIDITY EFFECT ON EXTENSION.
UNSIZED YARN.
SIZED YARN.
32'S UPPERS.
36'S SAKEL.
50'S SAKEL.
SHIRTING.(A)
SHIRTING (B)
MMS. ON 20" LENGTH.
RELATIVE HUMIDITY

FIG. 3

HUMIDITY EFFECT ON BALLISTIC WORK.

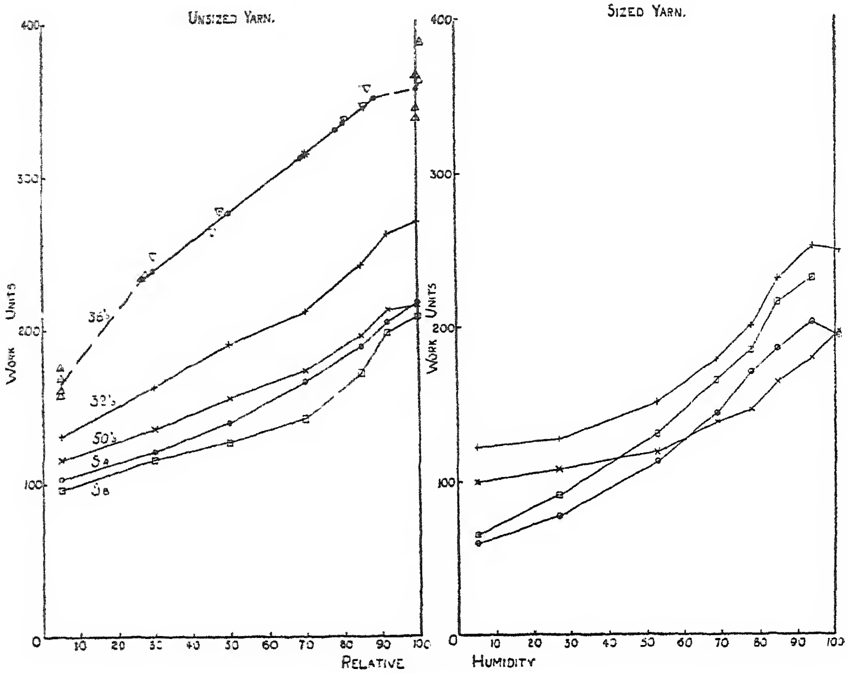


FIG. 4

HUMIDITY EFFECTS — GENERALISED CURVES.

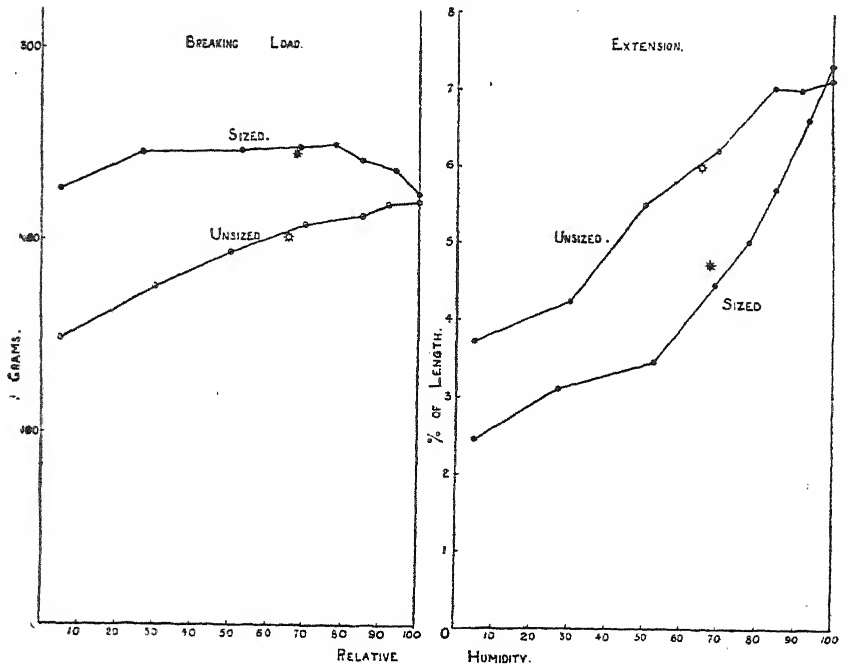


FIG. 5

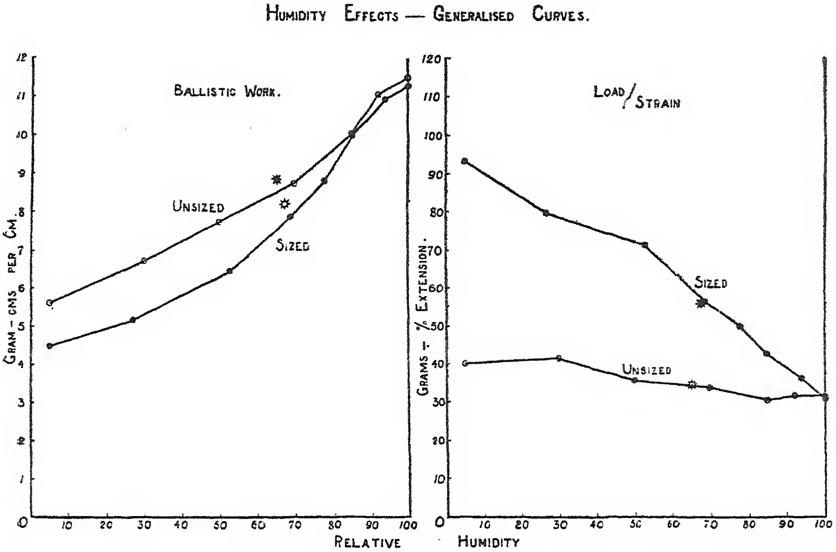


FIG. 6

DESCRIPTION OF EXPERIMENTS

(1) The methods of testing were described in recent Memoirs,[9,10] namely, the single-thread test for breaking load and extension, and the ballistic test for work of rupture. Testing was done in a room maintained at the desired humidity and temperature by a plant on the dew-point principle, and the conditions recorded in the tables are the mean values of observations taken during the test on a wet-and-dry bulb hygrometer near the testing instruments.

To avoid effects due to their history, samples were put through a standard cycle. From the unknown condition in which they were received from the mills, they were exposed to a 30 R.H. atmosphere for a day, stored at 70 R.H., and conditioned three days at the humidity in which they were tested. A controlled box, 3 feet cube, and smaller glass jars were used for preliminary conditioning. Control tests showed that greater latitude is allowable so the cycle was not always rigidly adhered to, but all the samples were treated so that they would be in the condition defined by this cycle. The object of this is to avoid after-effects due to excessive dryness or moistness, and to ensure equilibrium under the given conditions. Moisture regain determinations were made on some of the broken unsized specimens and did not show any systematic deviation from the absorption relation for raw cotton given by Urquhart and Williams.[14]

(2) A series of tests were done on a 36's Sakel yarn to define the humidity effect as precisely as possible, and to see how far the changes are consistent and reproducible. To this end, the yarn was chosen as the most regular obtainable and bobbins were taken from the continuous production of single spindles. Tests were made on "cut-skein" samples,[9] so that the specimens were very closely identical and the differences are much more accurate than is indicated by the probable errors, which are calculated from the variations among the individual specimens tested at each humidity.

The Moscrop test had to be made on continuous lengths, but the six bobbins were unchanged for the seven tests.

The results are given in Table I. and Fig. 1 in the units observed. The scatter of the points shows how indefinite the relation would be if tests were as usual made on independent random samples, but the regular slopes prove that the effect of humidity itself is very consistent and, moreover, that the control of conditions was satisfactory and reproducible.

Bobbins from two known spindles were used and are distinguished in the figure. The extension of the stronger set was consistently higher than that of the other, and was brought on the same curve by a constant subtraction of 3·5 mm. To obtain the effect of humidity on breaking load and work, unobscured by sampling differences, the mean value of the points near 70 R.H. and the mean slope of the lines from them were found. An addition was then made to the values for each pair of tests to bring the point nearer 70 R.H. on to the line of mean slope through the mean point. This gave the very well defined relations shown in Figs. 2 and 4.

Table I.

Humidity Effects on Unsized 36's Sakel Yarn

Single-thread Tests (120 to each figure), on 20 in. lengths—

Test No.	R.H. %	Breaking Load ± 2 gm.	Extension mm. ± ·2	R.H. %	Breaking Load	Extension	Slope of B.L.
11	71	359·1	33·4	30	298·6	27·2	1·48
3	71	324·6	31·6	46	285·8	25·3	1·09
2	69	343·8	31·4	48	313·0	27·0	1·47
4	73	346·4	32·1	81	363·0	33·5	2·07
10	72	371·9	36·6	86	389·5	36·8	1·26
5	66	340·9	30·5	87	376·7	32·2	1·28
Mean	70·3	347·8	32·6	—	—	—	1·44 ± ·094
14	50	333·3	31·1	27	311·6	27·9	0·94
15	81	376·8	37·1	28	304·8	27·1	1·36
9	86	375·1	37·3	100	375·6	38·6	0·04
6	89	368·0	28·9	Wet	365·5	35·0	−0·23

Ballistic Tests (50 to each figure, on 30 threads of 24 in. length—

Test	R.H.	*Work Units ± 1	R.H.	Work	Slope
11	71	321·1	30	250·5	1·72
3	71	304·5	46	251·0	2·14
2	69	311·7	48	274·9	1·75
4	73	311·6	81	325·4	1·73
10	72	333·6	86	361·0	1·96
5	66	313·4	87	363·6	2·39
Mean	70·3	316·0	—	—	1·95 ± ·075
17	27	261·7	0	191·2	2·61
13	30	267·0	0	198·0	2·30
16	30	287·4	0	206·4	2·70
7	Wet	366·4	0	178·4	1·88
14	50	300·7	27	256·6	1·92
15	81	338·8	28	235·6	1·95
19	69	322·2	100	372·2	1·61
20	79	351·3	100	353·8	0·12
9	86	357·3	100	354·2	−0·22
6	89	348·8	Wet	383·0	3·11
18	100	370·1	Wet	377·2	—

The slope is the change for 1 R.H. * Machine scale divisions; 1=92·17 gm. cm.

Moscrop Tests (450 to each figure)—

Test No.	3	5a	3a	4	4a	5	6
R.H.	46	66	71	73	81	87	Wet
B.L. gm.	401	432	441	450	463	496	483

(3) A series of tests were made on a set of four slasher-sized warp yarns and on the unsized yarns saved from the same beams. They were taken from the ordinary production of different mills for common trade purposes and chosen to span a range of quality. The particulars are given in Table II.

The pure sago size is of known composition and contains less than 10% of solids other than starch, viz. chemic, tallow, and soap. The size for the shirtings was an ordinary mixture of wheat starch and china clay. The percentage of size was found from the observed counts of sized and unsized yarns. Moisture regains were measured at a series of humidities in closed vessels and are given in Table II. From these values, assuming the regain of cotton given in the table, the regains of the sizes were calculated and the total absorption at 30, 50, 70, and 80 R.H. divided by that of the same dry weight of pure starch is given as the "hygroscopicity." This figure is of the order to be expected from the composition if the several components of the sized yarn absorb as in the free state.

The sized yarns were supplied in the form of balls of warp from the slasher; the unsized shirting yarns, similar balls from the same warps before sizing; and the two others on a number of bobbins from among those used to make the pure sized warps.

Table II.
Particulars of Yarns

Unsized Ring Warp Yarns—					
Designation	36's	50's	32's	Sa	Sb
Cotton	Sakel combed	Sakel combed	Uppers carded	American carded	American carded
Nominal counts	36	50	32	31	30
Observed	34·1	51·2	32·7	32·8	33·2
Nominal twist	—	27	20	—	—
Observed	23·4	30·4	24·9	21·8	21·8
Constant	4·0	4·2	4·3	3·8	3·8
Breaking length*	26·2	23·2	13·2	10·6	10·0
Extension %	6·5	6·1	6·6	6·2	6·0
Sized Yarns—					
Sizing	Pure Sago		Wheat Starch and China Clay		
% Size, nominal	16	13	58	50	
Observed	16·6	18·5	61·4	68·9	
Hygroscopicity	0·89	1·20	0·42	0·73	
Breaking length*	22·0	18·0	9·6	11·1	
Extension %	3·8	4·5	4·7	4·9	

* Breaking length in hanks at 70 R.H.

Table III.
Moisture Regains of Sized Yarns

R.H.	50's	32's	Sa.	Sb.	Cotton	Starch
30	4·58	5·56	3·45	3·88	4·20	8·5
50	6·50	7·60	5·25	6·01	5·9	12·3
70	9·57	10·1	8·43	10·62	8·4	16·5
80	10·98	11·1	9·78	13·0	10·3	19·2
100	28·9	29·6	54·2	72·3*	—	—
0	15·3	16·7	61·4	65·6	% size at 0.R.H.	

* Mildewed.

(4) It is known from previous control tests and experience that changes in yarn strength can be measured with much greater accuracy if the samples are taken from contiguous pieces of the same threads than if taken at random from a batch of yarn. In sampling from the bobbins, windings of 30 strands were made on a large reel and cut into four specimens. Alternate windings were grouped into two sets, one of which was tested at 50, 70, 92, and 100 R.H., the other at 0, 30, 85, and a repeat 70 R.H. The two tests at 70 R.H. show no significant difference (Table IV.), hence that the two series are directly comparable, and are a further check on the control and reproducibility of moisture condition.

Table IV.

Tests at 70 R.H.

Unsized yarn	50's 1st set	50's 2nd set	32's 1st set	32's 2nd set
Breaking load	209·5	205·4	247·0	243·7
Extension	30·6	30·7	33·1	33·5
Work	172·0	173·4	212·9	211·0

The values given in this and the following tables are the mean of 100 single-thread tests on 20-inch lengths, or of 30 ballistic tests on 30 threads of 24-inch length.

In sampling the balls of warp, the rope of yarn was split into tapes of 30 threads to the number of the specimens to be tested, and for a length sufficient to give one specimen, at each humidity. The lots were thus composed of the same threads, taken at random along the warp.

All four yarns were tested together on the same day after previous conditioning at each humidity, and the mean values are recorded in Table V. The conditions at "100 R.H." are literally described, the yarns having been conditioned over pure water and tested in a room where mist and condensed water were present. For the "dry" condition they were previously dried over phosphorus pentoxide, the room made as dry as possible, and the tests made with the least delay after removing the specimen from the desiccator. The mean of the results is given for the ballistic tests and for the sized yarns of Table VI., but each set of unsized single-thread tests, occupying about 15 minutes, showed a distinct trend upwards when plotted against time of exposure. A sufficiently well-defined line could be drawn through this plot to give a value for zero exposure which is a better value than the mean. The values obtained at this driest condition, at which the effective humidity is doubtful, are plotted at 5 R.H., an arbitrary approximation.

(5) The sized yarns, in the form of balls of warp, were sampled as described, a control test having first been made for the regularity along the threads and across the warp. Nine specimens were taken from the same length of 5 ropes of 30 threads of the Shirting "b" yarn, tested ballistically, and means taken of the columns and rows. The sum of the squares of the deviations from the means of the columns was divided by 8×5 and the square root taken, giving 10·59. The corresponding figure for the rows was 9·36, for the whole group $11{\cdot}86 \pm 0{\cdot}85$. The similarity of specimens containing the same threads is hardly as strongly marked as that due to simultaneity of sizing and neither is very definite.

The results of tests done under dry conditions when plotted showed little effect of exposure, and the means are given. For the "wet" conditions, the yarn was immersed in water before testing at 94 R.H., as a saturated atmosphere is too uncomfortable. Throughout the tests, a temperature of 75° F. was maintained, as representing average conditions in a weaving shed, except for the test at 94 R.H., this humidity only being attainable in the circumstances by lowering the temperature to 67° F. Judging by the tests on the influence of temperature, the effect of this difference should not appreciably affect the relations.

(6) The relations between the humidity and the strength, extension, and work of each yarn are shown more clearly by the plots of Figs. 2–4. Those for the strength of the unsized yarns show two definite features—the humidity at which the strength attains its maximum and the slope at lower humidities. These are given in Table VII. together with the same quantities from data given by Fuwa and Turner.

Table V.—Humidity Effect on Unsized Yarns

R.H.	50's	32's	Sa.	Sb.
Breaking Load in grams ± 2—				
*Dry	160	168	144	133
30	186·1	207·4	163·9	147·0
50	195·3	233·3	179·0	167·4
70	207·4	245·3	194·9	182·3
85	213·9	246·1	192·1	199·6
92	217·3	252·6	196·8	207·6
100	217·6	251·4	197·3	214·6
Mean 65·4	204·0	236·9	185·3	180·8
σ 22·8	11·7	16·2	12·4	21·9
Extension in millimetres ± 0·2—				
*Dry	22	21	17	17
30	22·9	24·6	20·1	18·7
50	28·7	30·9	26·1	25·5
70	30·7	33·3	31·5	30·2
85	35·4	37·8	34·7	34·6
92	35·3	37·4	34·5	34·4
100	34·5	38·8	35·7	35·0
Mean 65·4	30·6	32·8	29·4	28·7
σ 22·8	4·7	4·9	5·6	6·0
Ballistic Work in units ± 2—				
Dry	115·4	130·8	102·6	95·8
30	135·3	162·7	121·0	115·4
50	155·3	190·5	139·0	126·8
70	172·7	212·0	165·3	142·2
85	196·1	241·9	188·1	171·6
92	213·0	261·4	204·2	197·7
100	215·6	269·6	217·3	208·5
Mean 65·4	174·5	213·7	163·5	150·7
σ 22·8	27·8	35·2	30·6	30·1

* Extrapolated to zero exposure.

Table VI.—Humidity Effect on Sized Yarns

R.H.	50's	32's	Sa.	Sb.
Breaking Load in grams ± 2—				
Dry	—	270·1	206·7	218·0*
27	221·3	298·7	229·1	238·1
53	224·9	290·7	212·7	250·9
69	227·7	295·2	213·5	255·4
78	228·7	291·8	217·9	258·1
85	221·2	281·2	212·3	253·1
94	217·6	280·0	203·7	246·2
Wet	203·4	260·5	205·2	231·8
Mean 67·7	223·6	289·6	214·9	250·3
σ 22·3	3·91	6·87	7·63	6·59
Extension in millimetres ± 0·2—				
Dry	—	14·2	10·0	13·4*
27	15·2	17·4	14·9	15·4
53	16·1	18·7	17·3	18·2
69	19·5	22·9	24·7	23·6
78	21·3	25·9	28·5	26·5
85	24·7	28·6	31·2	30·7
94	29·6	33·2	36·5	34·1
Wet	33·8	38·4	38·3	36·1
Mean 67·7	21·1	24·5	25·5	24·8
σ 22·3	5·0	5·5	7·5	6·6
Ballistic Work in units ± 1—				
Dry	99·9	122·5	59·4	66·4
27	108·7	127·2	77·4	91·5
53	119·6	150·2	112·5	130·5
69	138·8	178·1	143·8	164·9
78	146·4	199·8	169·6	184·3
85	163·6	229·6	184·9	215·4
94	179·2	251·3	202·3	230·9
Wet	196·9	248·4	193·2	—
Mean 67·7	142·7	189·4	148·4	169·6
σ 22·3	24·2	43·1	42·9	47·8

* A smaller test on 50 specimens broken at 27 R.H., with particular care to minimise exposure, gave the result B.L. 240·3 gms., extension 11·7 mm.

Table VII.

(*a*) Change of breaking load for 1 R.H. as percentage of value at 70 R.H.
(*b*) Value of R.H. where breaking load attains its maximum. B.Lth. = Breaking length in hanks at 70 R.H.

Yarn	B.Lth.	(*a*)	(*b*)	Yarn	B.Lth.	(*a*)	(*b*)
36's Sakel ...	26	·41	87	Tyre cord[4]			
50's Sakel ...	23	·26	92	Arizona ...	24	·33	83
32's Uppers	13	·25	92	Uppers ...	23	·36	85
Shirting "a"	11	·39	70	Turner[12]			
Shirting "b"	10	·53	100	2/45's Eg.	31	·16	80
Mean ...	—	·37	88	2/45's Am.	23	·53	to
				32's Eg.	22	·53	90
36's (Moscrop)	35	·48	87	2/58's Eg. mer.	29	·68	—

A more general and absolute reduction of the data is given by considering separately the extent of the changes and the form of the curves. The mean of the values on each curve is found, excluding the dry and wet values, and the standard deviation of the series from this mean. The latter, as a percentage divided by the standard deviation of the series of humidities, gives a relative measure of sensitivity (Table VIII.). The individual deviations are expressed as a ratio to the standard deviation (D/σ) and a mean of these ratios taken over the four yarns. Generalised curves reconstructed therefrom (Figs. 5 and 6) show most clearly the nature of the effects on the several properties. Table VIII. the specific differences between the several yarns.

Table VIII.
Sensitivity to Humidity

	50's	32's	Sa.	Sb.	Mean
Breaking Load—					
Unsized	0·25	0·30	0·29	0·53	0·34
Sized	0·28	0·11	0·16	0·12	0·14
Extension—					
Unsized	0·67	0·65	0·83	0·92	0·77
Sized	1·06	1·01	1·33	1·18	1·15
Ballistic Work—					
Unsized	0·70	0·72	0·82	0·87	0·78
Sized	0·76	1·02	1·30	1·26	1·08
Load/Extension—					
Unsized	0·48	0·40	0·64	0·51	0·51
Sized	1·04	1·11	1·60	1·20	1·24

The figure is an average for each curve of the change (per cent. of the mean value) for 1 R.H.

Both these questions are considered in the Introduction and Summary. The cause of specific differences is somewhat complex and further analysis of the two outwardly similar shirting yarns was attempted in view of the marked differences in the effects of humidity and sizing, especially on the breaking load. Both are greater in the "b" yarn, and it would seem that in this the hairs may be longer or better parallelised to allow a higher maximum of aggregate strength when effectively gripped. The projected diameters of the two yarns were, in arbitrary units, (*a*) 2·56 ± ·28, (*b*) 2·54 ± ·28; the staple lengths, in millimetres, (*a*) 19·3 ± ·1, (*b*) 20·6 ± ·1. Both differences are in the direction expected but are small and inconclusive as the determining factors in the difference of behaviour.

(7) Fuwa's[4] results on tyre cords, when replotted against humidity, converting the regain figures by the absorption curve, yield a graph very similar to that for the breaking load of unsized yarn (Fig. 5), and quantities about the same as those for single yarn (Table VII.). The actual humidities, not given, appear to have been 0, 10, 30, 50, 70, 80 . . . R.H., but the margin of uncertainty cannot affect the relation significantly.

Attention should be drawn to some data given in a lecture report by Turner[12] on the subject of this paper and those quoted.[9] It is a general survey of a number of effects on several textiles and the individual relations on the length of specimen and rate of loading are not defined sufficiently to use in conjunction with the work of the previous Memoirs,[9] but the results on the humidity effect are fully comparable. Tests at approximately 30, 70, 90 R.H., and wet, indicate a constant maximum reached about 80 R.H. after an increase at varying rates. As these are only determined by two points of unknown precision, the slopes of the single Egyptian and the two-fold American are quite normal, but the two-fold Egyptian is abnormally insensitive, while a similar mercerised yarn is unusually sensitive. Of these two, the hairs in the former appear to be well gripped even at low humidities, a fact also indicated by the extraordinary breaking length, while the mercerised hairs slip most easily when dry.

(8) Matthew[8] finds that the composition of size has little influence on the breaking load and extension of linen yarns, acting apparently only as a kind of lubricant to smooth the surface. Its function is much greater in cotton yarns, as may be seen from the different structure, discrete as against continuous fibres. The previous results show marked specific differences in the effect of the different sizes, but such differences are shown more clearly by the properties of one yarn, the 36's Sakel, sized with various pure sizes. At 60 R.H. the mean values of several of the set were—

Breaking Load ...	Unsized	352 gms.	Sized	437	398	434	409 gms.
Extension ...	,,	6·45	,,	3·72	3·95	3·52	4·62 %

These examples are chosen to show not representative but rather extreme variations.

NOTE ON HYGROMETRY

General discussions on the methods available and their theoretical bases can be found in recent symposia.[3,6,11] The question needs consideration to determine the instrument or instruments which best combine accuracy and convenience in routine and check measurements under the special conditions of textile factories and laboratories. Instruments were made or procured on the following principles—

(1) Absorption (to dryness)—(*a*) Gravimetric; (*b*) Barometric; (*c*) Volumetric.

(2) Cooling (to saturation)—Regnault or Daniell dew-point hygrometer.

(3) Evaporation. Wet-and-dry bulb hygrometer—(*a*) Unventilated; (*b*) Sling; (*c*) Ventilated.

(4) Hygroscopicity—(*a*) Length of animal hair; (*b*) Weight of textile material; (*c*) Elasticity of filament.

These instruments were used in sets under the same conditions, and the conclusions on them are as follows—

Method 1 (*a*)[3] is a standard absolute method of high accuracy but slow and laborious, suitable in general only as a check.

In Tyndall's[3] convenient instrument, the change in pressure is directly observed on a manometer when the air in a brass tube is dried by a slider filled with absorbent. The difficulty in practice is that it also acts as a very efficient air thermometer and that a rise of temperature occurs through the absorption, the friction, and the presence of the observer. By the time a steady state is reached the room temperature may have changed and corrections are necessary.

Better results were obtained with the instrument due to Shaw,[3] in which the change in volume is measured of air dried by sulphuric acid. The last stages of absorption are rather slow and the results tend to be low through incomplete absorption. In convenience and accuracy it did not seem to offer any advantages over older methods.

The dew-point hygrometer gives, by a virtually absolute measurement, the most convenient check or calibration of the rapid routine instruments, and was so used by Glaisher in preparing tables for the unventilated wet-and-dry bulb hygrometer. Care in making and using it to obtain a sharp definition of the coming and going of the dew is necessary, also to avoid effects due to the body of the observer.

The use of hygroscopic materials allows continuous record of humidity changes and control of room conditions, but is subject to the complicated effects of history in the absorption of colloid materials, time lags, hysteresis, and permanent effects after extreme conditions and secular changes. The measurement is purely relative to calibration against an absolute method, and the hair hygrometer must be regularly checked and adjusted. It is most useful for following small variations throughout the day. The weight of a piece of textile material gives a useful measure of the condition of the material under process or test, rather than of the momentary state of the air. A convenient check on the conditions in a sealed chamber[7] is obtained by measuring the rigidity of cotton hairs, which is extremely sensitive to humidity changes.

For regular routine measurement of room conditions, the wet-and-dry bulb hygrometer, in one of its several forms, offers the most advantages. They are subject to the following sources of error—

High reading—Incomplete wetting of bulb (muslin too thin, long, or greasy; water impure or running dry). Incomplete isolation of dry from wet bulb. Nearness of observer's body.

Low reading—Radiation on dry bulb.

Either high or low—Thermometer calibration and reduction tables. Variations in ventilation.

Most of these are questions of design or technique, to be controlled by inspection of experts and the training of observers. The unventilated type is much more sensitive to the errors introduced by the environment, and hence definite limits cannot be placed on the probable divergence of results from those of the ventilated type. The essential and systematic difference lies in the question of ventilation and reduction tables.

The soundest reduction formula is—

$$p = p' - A(t - t'), \quad \text{R.H.} = p/p_0 \times 100. \qquad \ldots\ldots 1$$

where p is the actual vapour pressure, p' the maximum pressure at the wet-bulb temperature t', p_0 at the dry-bulb temperature t. A is the product of the barometric pressure B and a factor C practically independent of temperature but varying with the wind velocity. For practical purposes B may be taken as 760 mm. of mercury, and A is then a function of air velocity only, and determines the reduction tables, which would lead to identical results from ventilated and unventilated hygrometers used under ideal conditions. Its value in inches of mercury is given against air velocity in feet per minute in Table IX. obtained from the curve in the Dictionary of

Applied Physics[3] (p. 424). Above 600 feet per minute the value has been found not to change materially up to 8,000 feet per minute, but the change is rapid at low velocities, hence the liability to error in reducing readings of unventilated hygrometers used in draughty rooms.

Table IX.

Velocity	0	20	40	100	200	400	600	1000	ft.
Constant A ...	0·0190	175	165	149	135	120	111	102	in.

Glaisher's Tables are based on the formula—

$$d = t - a(t - t') \qquad \ldots\ldots 2$$

where d is the dew-point, a a factor varying with the temperature (p. 420, *loc. cit.*). The values of this factor were obtained empirically by simultaneous readings of Daniell and standard hygrometers at Greenwich Observatory. Reduction errors can then arise from (1) a varying with $(t - t')$, (2) differences in air velocity and radiation in the actual environment and those of Glaisher's observations, and both do arise in practice.

From Table X. it can be seen that the wet-bulb depression, according to Glaisher, exceeds the true depression in still air by an amount which increases with the latter, for the reason that if A be independent of t and t', then a must increase with $(t - t')$. Actually, Glaisher's Tables are very nearly correct for a velocity of 40 feet per minute, the velocity of air in weaving sheds is about the same, and the two errors roughly cancel each other. Roughly, for there are still systematic errors, minimising high humidities, magnifying low ones, and extra ventilation would mean generally low readings.

Table X.

Conditions			$t - t'$ ° F.					Apparent R.H.			
t°F.	R.H.	G.	0	40	200	600		0	40	200	600
70	88 ...	2·0	2·1	2·3	2·5	2·7	...	87·6	86·8	85·7	84·8
70	70 ...	5·8	5·2	5·6	6·1	6·5	...	72·0	70·5	68·8	67·1
80	75 ...	5·4	5·0	5·3	5·7	6·0	...	77·0	75·5	73·7	72·0
80	50 ...	12·3	10·7	11·4	12·3	13·2	...	55·2	52·8	50·0	47·3

The centre portion gives the thermometer differences which would be observed under the conditions of temperature and humidity given by the left portion when the air is moving with velocities 0, 40, &c., feet per minute, also (under G.) if Glaisher's tables were correct. The right portion gives the value of the humidity which would be found by using Glaisher's tables for reducing the readings.

The sling hygrometer or psychrometer is a cheap and convenient form of ventilated type, but it is questionable whether in factory use it would be much more reliable as the results are sensitive to the time and rate of swinging, if these be insufficient.

For the present work measurements were made with a ventilated hygrometer with standardised thermometers, the measured air velocity being 650 feet per minute. The automatic commercial instruments, with screened bulbs and automatically determined ventilation, are probably the most accurate instruments for use by inexpert observers in industrial rooms, and have against them only the detail of convenience, that readings are intermittent, and their greater cost. The reduction tables used were calculated from Equation 1, using the value of A 0·0006579 × 760 in mms. of mercury and degrees Centigrade, and they agree closely with the Smithsonian Tables. The only markedly divergent table among those examined was Jelinek's.

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59—TENSILE TESTS FOR COTTON YARNS THE RATE OF LOADING (*ADDENDUM*)

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In the paper recently published under the above title,[3] the need arose for data on the effect of rate of loading in testing fabrics, for comparison with that found in testing hairs and yarn. Those quoted appeared the best available, but did not allow a critically quantitative comparison. Another publication has since been found in which the question is explicitly dealt with, the effect also being expressed against the logarithm of the time of break, namely,[1] "The Effect of Rate of Loading on the Apparent Strength of Cotton Balloon Fabrics," by Dr. Guy Barr, to whom the writers owe an apology for the oversight.

A number of fabrics were tested on the Avery machine over a wide range of speeds, the time of break T varying from 13 sec. to $2\frac{1}{2}$ hours, and the relations obtained were expressed linearly against log. T. Writing the breaking load F, when T is 10 sec. F_1, the slopes of the lines are given in the Table I.

Table I.

Fabric	Weight gm/m²	$-dF/d.\log. T$	Remarks
Cotton "C"	80	$0{\cdot}059\ F_1$	Both warp and weft.
Linen	—	0·086	Technical Report, 1914–15.
2-ply Rubbered cotton	—	0·096	Warp way of straight ply.
Cotton "D"	65	0·103	Light airship material.
Canvas	210	0·111	Heavy balloon cotton fabric.
Mean	—	$0{\cdot}091\ F_1$	—

Barr tentatively explains the effect by supposing the fibres to slip less in rapid breaks, the fibre strength remaining invariant. It will be seen, however, that the rate of change of apparent strength of fabrics is the same as that found in hairs and yarn, and that no indication of greater slippage could be found in the latter after a slow break. The effect in all three seems to be accounted for quantitatively by the elastic imperfection of the cellulose of the ultimate fibre. This difference of interpretation is by no means of merely academic and theoretical importance, as the effect is involved not only in reconciling the results of different testers and in standardising testing conditions, but also in industrial application, viz., the slow yielding under a steady load, the loss of tautness of driving bands or aircraft fabric. In attempting to control or avoid these time-effects, an entirely different manner of attack is called for if the cause lies in the cellulose itself than if it be structural and influenced by sizing or weave.

In this connection, the variations of slope of the logarithmic relation should be considered. For single hairs,[2] the slopes are not defined exactly enough to indicate or disprove specific differences between cottons, though the mercerised cotton may be rather more susceptible. For variations among yarns there are available only the parallel results of standard, Moscrop, and ballistic tests, the ratios between which vary irregularly, in the

absence of sampling for the purpose, about those given by the yarn thoroughly tested from this point of view.[3] Effects of cotton, spinning, sizing, and humidity, are involved in the comparison of the ballistic and dead-weight tests made in the work on the effect of humidity.[4] Assuming a linear relation between load and extension, and that the final extension is independent of speed, a comparative figure of the slope $100/F_s \times dF/d.\log. T$ is given in Table II., where F_s is the breaking load in the slow test. The similar figure from the mean results at 70 R.H. of the ballistic and dead-weight tests given in the paper[3] on the rate of loading is 13.

Table II.
Slopes of Rate of Loading Effect on Warp Yarns

Unsized							Sized						
R.H.	50s	32s	Sa	Sb	Mean		R.H.	50s	32s	Sa	Sb	Mean	Mean
50	15	13	19	19	16	...	53	23	14	19	15	18	17
70	14	12	14	12	13	...	69	20	12	14	13	15	14
85	12	12	16	10	13	...	85	19	16	15	15	16	15
92	15	15	24	15	17	...	94	15	13	14	14	14	16
Mean	14	13	18	14	15	...	—	19	14	16	14	16	15

There appears in this table no significant influence of cotton, counts, combing, sizing, or even humidity. Returning to Table I., the last three slopes are not significantly different and no influence can be ascribed to the large differences of weight and of reinforcement. The only distinct variation is that shown by Fabric "C." which is the same as the single ply of the rubbered material, and the only feature to which this may be ascribed is the greater possibility of inter-fibral slipping. During the slow application of tension, excessive tensions will be released and the load more evenly distributed between the fibres, the structure will be made more compact by readjustment under compression, and the fabric strengthened so as to counteract the natural time effect in the cellulose.

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247,339	A187	248,814	A237	250,449	A279	252,358	A359	254,182	A360
247,398	A201	248,857	A230	250,456	A263	252,360	A325	254,236	A354
247,414	A201	248,888	A240	250,467	A277	252,384	A325	254,253	A350
247,421	A183	248,908	A230	250,569	A261	252,392	A326	254,254	A371
247,427	A187	248,912	A226	250,580	A257	252,423	A306	254,267	A352
247,463	A201	248,913	A227	250,582	A279	252,471	A304	254,318	A352
247,478	A182	248,988	A226	250,617	A257	252,503	A304	254,325	A360
247,480	A181	248,994	A223	250,623	A277	252,507	A326	254,354	A371
247,486	A181	249,005	A226	250,645	A268	252,564	A312	254,357	A352
247,487	A187	249,081	A226	250,658	A277	252,596	A306	254,374	A360
247,528	A199	249,102	A226	250,683	A257	252,646	A371	254,398	A355
247,588	A199	249,124	A230	250,704	A261	252,654	A301	254,428	A354
247,631	A187	249,141	A223	250,710	A263	252,665	A312	254,441	A371
247,645	A182	249,142	A223	250,746	A277	252,709	A312	254,447	A353
247,651	A182	249,167	A236	250,772	A261	252,719	A312	254,448	A360
247,661	A199	249,173	A223	250,773	A262	252,720	A312	254,458	A364
247,694	A199	249,196	A227	250,796	A268	252,734	A312	254,461	A360
247,701	A183	249,197	A231	250,821	A262	252,781	A312	254,507	A385
247,708	A182	249,198	A231	250,831	A268	252,811	A326	254,508	A372
247,714	A182	249,207	A238	250,886	A291	252,819	A312	254,531	A349
247,723	A187	249,214	A227	250,899	A277	252,857	A305	254,536	A361
247,731	A187	249,226	A231	250,915	A262	252,859	A313	254,537	A361
247,738	A199	249,230	A231	250,934	A268	252,873	A313	254,567	A354
247,755	A182	249,231	A231	250,941	A269	252,877	A306	254,581	A374
247,757	A200	249,253	A227	250,981	A270	252,878	A306	254,586	A353
247,758	A188	249,298	A227	250,992	A269	252,883	A313	254,609	A373
247,760	A188	249,331	A231	251,001	A290	252,926	A313	254,649	A373
247,783	A200	249,337	A227	251,014	A277	252,932	A396	254,662	A361
247,787	A200	249,341	A231	251,019	A277	252,973	A313	254,663	A361
247,812	A182	249,347	A227	251,022	A269	252,976	A327	254,685	A372
247,836	A182	249,369	A236	251,028	A262	252,984	A317	254,686	A372
247,848	A182	249,388	A231	251,038	A270	252,987	A313	254,695	A372
247,882	A182	249,392	A232	251,102	A277	253,035	A314	254,706	A372
247,909	A200	249,406	A236	251,112	A270	253,105	A326	254,720	A361
247,931	A201	249,407	A236	251,123	A263	253,121	A305	254,775	A361
247,959	A188	249,413	A237	251,126	A278	253,209	A301	254,796	A350
247,974	A179	249,434	A237	251,155	A278	253,216	A314	254,866	A361
247,975	A200	249,444	A227	251,156	A262	253,264	A314	254,871	A361
247,979	A183	249,449	A232	251,227	A278	253,319	A314	254,885	A362
248,007	A200	249,455	A232	251,249	A278	253,352	A305	254,927	A362
248,010	A188	249,471	A232	251,288	A262	253,354	A314	254,932	A362
248,029	A201	249,486	A232	251,303	A257	253,355	A314	254,933	A362
248,042	A178	249,490	A224	251,319	A257	253,374	A315	254,937	A374
248,043	A178	249,496	A237	251,357	A279	253,381	A315	254,950	A374
248,044	A179	249,564	A227	251,360	A257	253,383	A306	254,985	A374
248,045	A179	249,538	A236	251,446	A270	253,415	A315	255,003	A373
248,046	A178	249,582	A232	251,450	A269	253,422	A306	255,019	A364
248,054	A188	249,714	A227	251,452	A262	253,461	A326	255,094	A372
248,119	A188	249,729	A232	251,467	A269	253,465	A315	255,109	A374
248,147	A200	249,731	A232	251,469	A291	253,473	A315	255,110	A353

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255,124	A354	255,595	A354	256,273	A427	256,788	A418	257,235	A398
255,135	A362	255,623	A350	256,337	A400	256,807	A408	257,255	A399
255,200	A362	255,626	A373	256,342	A400	256,808	A418	257,258	A419
255,208	A362	255,669	A363	256,368	A407	256,809	A418	257,308	A399
255,210	A362	255,676	A354	256,390	A407	256,844	A397	257,315	A399
255,215	A372	255,715	A355	256,398	A407	256,854	A418	257,352	A427
255,218	A372	255,725	A373	256,416	A410	256,887	A397	257,353	A419
255,235	A382	255,775	A355	256,438	A410	256,898	A427	257,363	A408
255,248	A372	255,814	A363	256,450	A399	256,914	A397	257,410	A409
255,257	A373	255,852	A364	256,454	A417	256,917	A397	257,432	A419
255,261	A350	255,885	A354	256,462	A396	256,932	A408	257,476	A409
255,267	A353	255,909	A334	256,471	A407	256,948	A408	257,484	A409
255,270	A373	255,929	A374	256,479	A420	257,058	A418	257,491	A419
255,274	A353	255,962	A417	256,492	A396	257,070	A397	257,497	A399
255,283	A353	255,965	A406	256,559	A417	257,075	A397	257,498	A399
255,285	A353	255,985	A406	256,570	A393	257,097	A398	257,550	A399
255,297	A373	255,986	A396	256,576	A408	257,101	A398	257,554	A399
255,298	A382	255,994	A406	256,612	A408	257,102	A398	257,575	A409
255,304	A363	255,999	A407	256,621	A399	257,106	A418	257,634	A427
255,327	A354	256,000	A421	256,635	A420	257,117	A399	257,653	A430
255,383	A365	256,016	A407	256,639	A399	257,118	A398	257,654	A419
255,393	A363	256,051	A407	256,666	A417	257,128	A398	257,682	A409
255,398	A350	256,061	A407	256,692	A396	257,153	A420	257,700	A419
255,408	A363	256,072	A399	256,701	A430	257,160	A418	257,706	A420
255,412	A354	256,087	A420	256,710	A397	257,176	A398	257,733	A409
255,453	A373	256,094	A393	256,739	A430	257,177	A426	257,737	A409
255,476	A363	256,168	A407	256,740	A397	257,179	A426	257,755	A399
255,501	A373	256,205	A417	256,747	A408	257,192	A419	257,794	A409
255,527	A350	256,229	A421	256,749	A408	257,210	A398	257,810	A399
255,545	A354	256,238	A417	256,757	A393	257,215	A399		

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1,490,081	A155	1,544,631	A36	1,556,174	A123	1,565,390	A415	1,590,593	A392
1,495,143	A155	1,544,944	A36	1,557,117	A109	1,565,515	A415	1,590,594	A392
1,515,102	A406	1,545,144	A36	1,557,147	A123	1,565,516	A415	1,590,596	A392
1,517,366	A8	1,545,819	A129	1,558,265	A301	1,566,384	A392	1,590,600	A392
1,517,911	A210	1,546,679	A123	1,558,375	A301	1,573,200	A196	1,590,601	A392
1,522,560	A196	1,546,969	A129	1,559,282	A180	1,579,121	A276	1,590,606	A392
1,522,561	A196	1,547,138	A44	1,561,285	A240	1,580,844	A222	1,590,607	A392
1,529,500	A19	1,549,798	A83	1,562,076	A301	1,584,871	A327	1,591,922	A371
1,531,343	A8	1,549,906	A129	1,564,378	A129	1,587,384	A325	1,596,906	A392
1,532,427	A108	1,550,360	A123	1,564,943	A109	1,588,951	A416	1,598,305	A416
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532,391	A416	584,708	A8	587,653	A104	591,075	A416	595,286	A416
560,535	A8	584,802	A12	587,935	A100	591,924	A240	595,585	A311
564,437	A8	584,855	A108	587,945	A69	592,088	A225	595,705	A235
573,739	A49	585,451	A19	588,209	A126	592,201	A228	596,018	A311
575,652	A49	585,530	A42	588,531	A69	592,205	A108	596,145	A311
575,818	A49	585,547	A42	588,582	A69	592,403	A197	596,314	A300
578,671	A35	585,881	A35	588,792	A124	592,452	A196	596,776	A359
579,048	A35	585,952	A36	588,852	A126	592,717	A225	597,094	A349
579,896	A49	586,080	A36	588,862	A141	592,752	A229	597,123	A359
580,252	A35	586,138	A196	589,008	A124	593,170	A225	597,337	A352
582,390	A49	586,310	A196	589,031	A145	593,223	A229	597,559	A359
582,391	A49	586,515	A42	589,267	A146	593,920	A267	597,809	A392
582,548	A35	586,799	A75	589,361	A139	594,059	A267	597,850	A406
582,956	A49	586,806	A75	589,370	A139	594,146	A108	597,889	A396
584,346	A12	587,337	A104	589,833	A229	594,192	A261	598,096	A406
584,383	A325	587,367	A108	590,532	A225	594,524	A129	598,336	A396
584,643	A7	587,380	A104	590,738	A196	595,251	A261	598,713	A197
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62,246	A225	326,335	A225	408,294	A50	410,582	A36	416,772	A197
117,305	A225	365,668	A104	408,342	A35	410,586	A352	417,707	A370
125,748	A225	372,823	A38	408,404	A50	413,239	A82	418,620	A416
185,931	A225	389,024	A49	408,414	A50	413,818	A50	419,061	A195
234,543	A225	400,190	A35	408,523	A50	415,124	A85	419,464	A130
236,294	A225	403,785	A26	408,594	A35	415,583	A109	422,070	A197
252,706	A33	406,333	A35	409,958	A50	415,652	A36	428,263	A416
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No.	Month of Issue	Page	Corrigenda
1	January ...	A20	Patent. *For* 240,041 *read* 241,041.
1	,, ...	A20	Patent. *For* 239,554 *read* 239,553.
2	February ...	A47	Abstract No. 4. *For* 48 *read* 47.
3	March ...	A85	Patent. *For* 242,283 *read* 243,283.
3	,, ...	A85	Patent. *For* 242,285 *read* 243,285.
4	April ...	A112	Patent. *For* 243,026/7 *read* 244,026/7.
4	,, ...	A115	Abstract No. 2. *For* 2 *read* 42.
7	July ...	A179	Patent. *For* 247,979 *read* 247,974.
7	,, ...	A179	Patent. *For* 247,044/5 *read* 248,044/5.
8	August ...	A222	Abstract No. 6. *For* 781 *read* 78.
10	October ...	A298	Abstract No. 5. *For* Mycol. *read* Entomol.
10	,, ...	A335	Abstract No. 3. *For* J. Chem. Soc. *read* J. Soc. Chem. Ind.
11	November...	A347	Abstract No. 4. *For* J. Ind. Chem. *read* J. Ind. Eng. Chem.
11	,, ...	A372	Abstract No. 7. *Insert* E.P. 255,216.
12	December ...	A408	Patent. *For* 256,567 *read* 256,576.

THE JOURNAL OF THE TEXTILE INSTITUTE

ABSTRACTS

NOTES.—In the references to publications abstracted the name of the publication is followed by the Year, Vol. and Page No. (or Nos.).

Literature relating to the composition and manufacture of dyestuffs is not dealt with in the abstracts of this *Journal*.

1—FIBRES AND THEIR PRODUCTION

(B)—ANIMAL

The Presence of Tryptophan in Silk Fibroin. E. Hiratsuka. *Biochem. Z.*, 1925, **157**, 46.

No positive proof has been given so far of the presence of tryptophan in silk fibroin. The Adamkiewitz, the glyoxylic, and the p.-Dimethylamido-benzaldehyde reactions are all given by fibroin. Tryptophan was prepared in pure conditions from the fibroin hydrolysed by baryta. The amount of tryptophan present was determined (1) gravimetrically, and (2) colorimetrically (method of Herzfeld).

	(1) Per cent.	(2) Per cent.
Cultivated silk ...	0·75	0·6
Yamamai silk	2·86	2·24
Chinese Tussah silk ...	4·14	2·22

The tryptophan isolated was optically inactive. —B.S.R.A.

(C)—VEGETABLE

The Need of the Flax Industry. J. G. Crawford. *Text. Rec.*, 1925, **43**, No. 511. p. 75.

In this article the present condition of the Russian and non-Russian supply of flax is discussed. The former is stated to be difficult to gauge, but it is thought the increase in acreage will continue and in time, some years hence, the full Russian supply will be available once more. It is to the non-Russian or Western Europe area that the industry looks for its supply of the finest and strongest fibre. Here the supply is not equal to the demand and the most urgent need of the industry is more and cheaper flax in these grades. It is now agreed by agriculturists that flax-seed has deteriorated and become a mixture of poor and unsuitable strains. Therefore selection of seed is imperative. Several governments and organisations of various kinds have taken this matter up and experiments are being commenced in that line. Hitherto only one selected strain of seed, commonly known as the J.W.S., has become of commercial importance and developed to its present extent of sowing 450 acres by the Linen Industry Research Association. Other varieties are, however, now coming forward, some of which give every promise of being a decided improvement even on that seed. In the opinion of the author it is in selection that the salvation of the linen industry lies. —L.I.R.A.

Straw; An Investigation of the Colouring Matter in——. C. G. Schwalbe and G. A. Feldtmann. *Berichte*, 1925, **58**, 1534-1539.

A study of the products extracted from wheat straw, rye straw, and pine woods by extraction with sodium hydroxide and sulphuric acid under pressure. Attention is directed to the occurrence of *d*-glucuronic acid in such plant products, and two methods of estimation are given, with a table of the results obtained. —L.I.R.A.

Cotton Cultivation in French West Africa. *Rev. Textile*, 1924, **22**, 467.

Native production is reported to be increasing, and export of raw cotton rose from 70 tons in 1922 to 198 tons in 1923 in addition a certain quantity was consumed by native spinners. The area under cultivation by the Compagnie de Culture du Niger is at present 3,000 hectares, with a possible yield of 400 kilos. per hectare. Some information is given regarding cultivation in other French colonies. —B.C.I.R.A.

Cotton Cultivation in French West Africa. *Rev. Textile*, 1924, **22**, 185-187.

An extract from a report to the Academie d'Agriculture of a French mission sent to study cotton growing conditions in French West Africa. The authors of the report after briefly reviewing world conditions of cotton supply and the urgent need of

developing new sources of raw cotton for the French textile industry, state that, in their opinion, irrigation systems such as those of upper and lower Egypt cannot be introduced generally by reason of cost, &c. and, indeed, are not entirely desirable where the need is not so much for a high quality staple but for one of good average quality. They suggest that cultivation without irrigation is feasible in the valleys of the Niger and Bani and in the alluvial districts of Senegal, and consider that increase in the cotton crop must be brought about by (1) selective breeding of native cottons by native cultivators, and, more important, (2) intensive cultivation by Europeans, in both cases employing non-irrigation systems. —B.C.I.R.A.

Cotton Cultivation in the French Colonies. F. Michotte. *L'Avenir Textile*, 1925, **7**, No. 5, 207-210.

Many attempts under French control to develop the cultivation of textile fibres during the last 30 years have failed. The failures have been due to the general lack of technical efficiency, undue precipitancy in expansion, and the use of unsatisfactory machinery, all signs of the inexperience of the promoters. Previous adverse criticism by the author has thereby been justified. For similar reasons and in view of the low yield, the large amount of manual labour necessary, the cultural difficulties, and the numerous irremediable diseases, he considers the success of French efforts to stimulate cotton cultivation as doubtful. This opinion is supported by the last two years' experience as well as by the previous twenty years' results.
—B.C.I.R.A.

(D)—ARTIFICIAL

Cellulose Acetate Silk: Properties. K. Homolka. *Kunstseide*, 1925, **7**, 144-146.

A brief description of acetate silk and its manufacture and properties. The difficulties encountered in dyeing are largely overcome by a preliminary saponification to remove some of the acetyl groups. The "immunity" to dyes of cellulose acetate may be of importance for securing numerous colour effects with the silk. The lesser swelling properties of acetate silk in water as compared with the older artificial silks may secure its wider application in the manufacture of washing fabrics.
—B.C.I.R.A.

Viscose Solution: Ageing. R. Bernhardt. *Kunstseide*, 1925, **7**, 169-174.

The author briefly reviews current theories of the ageing process, and gives the results of investigating the recent hypothesis that ageing consists in reduction of the degree of dispersion of the particles. He investigated colour change during ageing, size of particles at different stages of the process, opalescence, and viscosity. He found that the colour change was due to the action of sodium hydroxide in excess of carbon disulphide used in the process or resulting from the xanthate during ageing, and not due to decreased dispersion. By ultrafiltration of freshly prepared and aged viscose he showed that the dispersivity of the former was of the order of that of Congo Red, and lessened with ageing. The opalescence of viscose does not result from colloidal particles of xanthate, but is found to be due to a suspension of carbon disulphide. Ultramicroscopic examination did not give very significant results, but confirmed the ultrafiltration results. From measurements, at atmospheric and at reduced pressures, of the viscosity of viscose at different stages of the ageing process two curves were obtained which show striking viscosity differences considering the small pressure difference. The differences are ascribed to the fact that viscose is an elastic colloid, the elastic properties increasing with age. The extent of ageing was determined by titration with ammonium chloride solution which gelatinises viscose. The action of ammonium chloride is found to be specific and not the general action of an electrolyte.
—B.C.I.R.A.

Viscose Piston Pump. E. Gerberich. *Kunstseide*, 1925, **7**, 99-100.

A piston spinning pump is described which is suitable for pumping viscose, and is an improvement on the piston pumps hitherto experimented with in that fluctuations in speed are almost completely neutralised by accessory pistons working against the main piston. —B.C.I.R.A.

Cellulose Xanthates: Preparation; and Viscose: Ageing. R. Wolffenstein and E. Oeser. *Kunstseide*, 1925, **7**, 2-5, 27-31, 74-78.

The authors describe the preparation and discuss the constitution of the two known cellulose mono-xanthates and also of the di-xanthates which they have prepared from cellulose acetate. While only two of the hydroxyl groups of the cellulose molecule appear to react to give the mono-xanthates, it is possible to act on three of the hydroxyl groups of the molecule with carbon disulphide if the triacetate of cellulose be employed. In discussing the nature of the ageing process the authors find that the reactions of the mono-xanthates can be explained by assuming that the alkali-containing groups of the molecule are split off, leaving the residue—

$$\begin{array}{c} OH\text{—}OH \\ \downarrow \quad \downarrow \\ \text{—}C_6H_8O_3\text{—} \end{array}$$

they conclude that this is what occurs during ageing, and that no degradation of the molecule takes place. —B.C.I.R.A.

Cellulose: Depolymerisation. E. Heuser. *Z. Elektrochem.*, 1925, **31**, 498-502.

In studying the problem of depolymerisation of cellulose, the authors selected a

number of regenerated celluloses and identifiable products obtained from cellulose by controlled hydrolysis or other means, for example, Cellulose A, Hydrocellulose I, Cellulose Dextrin I. These products were methylated until water-soluble substances were obtained, and it was found that those substances containing 2 to 2·5 methoxyl groups to every $C_6H_{10}O_5$ group were soluble in cold water. These alone were examined, and a very careful examination was made of certain properties, namely, (1) hydration temperature (temperature at which the product, precipitated by heat, goes again into solution), (2) softening temperature, (3) number of methylations necessary to obtain a water-soluble product, (4) the molecular weight. In a tabular statement it is shown that these properties all vary regularly according to the previous treatment of the original cellulose, and that hydration temperature increases and softening temperature and molecular weight decrease in a way corresponding to the degree of degradation brought about in the original cellulose. In other words, the molecular weights of the water-soluble products show that the variation in their properties is the result of depolymerisation of cellulose. —B.C.I.R.A.

Viscose Silk: Strength and Stretch. P. Krais. *Z. angew. Chem.*, 1925, **38**, 838.

The apparatus devised by the author for determining the strength and extension of single fibres has been improved, and it is now possible, especially with long fibres such as those of artificial silk, to obtain consistent results. A particularly good viscose silk of 7·2 deniers had a breaking load of 11·5 grams and a breaking stretch of 31·7%. The decrease in strength of the viscose in the wet state was 41·3% and the increase in breaking stretch was 29%.

—B.C.I.R.A.

Cellulose: Isolation. Schrohe. *Papier-Fabr.*, 1925, **23** (Verein Zellstoff Ingenieure Section), 655-658, 665-668, and 687-689.

A review of the patent literature of the period 1898-1925, relating to the isolation of pure cellulose and its treatment for particular purposes.

—B.C.I.R.A.

Wood Cellulose: Purification. C. G. Schwalbe. *Papier-Fabr.* (Fest und Auslandh), 1925, **23**, 97-107.

A review of some recent innovations in the digestion of wood pulp and the bleaching and purification of wood cellulose.

—B.C.I.R.A.

Viscose Silk: Theory of Manufacture. R. O. Herzog. *Papier-Fabr.* (Fest. und Auslandheft), 1925, **23**, 115-117.

The author discusses the physical and chemical phenomena, established and surmised, attending the individual steps of the viscose process.

Preparation of the soda cellulose—Cellulose is treated with caustic soda, as in mercerisation, and a soda-cellulose compound is obtained. Already, in this first step, the cellulose probably experiences chemical and physical changes which may be responsible for the sensitivity of artificial silk to water.

Ageing—The soda-cellulose is allowed to stand for some time. If the cellulose crystallite is considered as a cube (a sufficiently close approximation), it is found that, during ageing, the length of the edge of the cube (referred to the length of the edge of the crystallites in the regenerated cellulose) has decreased; after 20-40 hours it is less by about one-third, and at the end of 68 hours it is only about half of the original length.

Sulphiding—The soda-cellulose is treated with carbon disulphide (an amount about one-third less than the theoretical quantity required to form the xanthate is used), and the product is dispersed in caustic soda. The chemical nature of the process is still unexplained, but it is probable that the dispersed viscose particles are as big or contain as much cellulose as the aged soda-cellulose particles before treatment with carbon disulphide.

Ripening—Various changes take place during ripening and it is not known to what extent they are related. They include —(1) Chemical changes; the mode of union of the sulphur changes with increasing ripening. (2) Solvation changes (*i.e.* in the retention of solvent by the micellæ). (3) Adhesion or agglomeration of the micellæ so that the originally liquid sol becomes more jelly-like until it finally forms a jelly which on application of pressure becomes a solid cake. The greater the degree of ripening the more advanced are these processes.

Spinning—The ripened viscose is spun through fine jets into a precipitating bath in which the viscose is coagulated and cellulose regenerated.

Coagulation consists in a closing together of the molecules which, possibly by reason of their closeness, possibly owing to condensing forces, so far adhere to each other that they form a coherent thread. Generally, the micellæ are not oriented with respect to the axis of the thread, but form an unorganised mass. The *action of the acid*, apart from the chemical processes of cellulose regeneration, effects a series of changes of which the most important are the fixation of the micellæ to crystallites. By analogy with the formation of soda-cellulose and the xanthate, one xanthate micelle should furnish one cellulose crystallite. The mode of adhesion of the crystallites is unknown; the substances accompanying cellulose may form a cementing material, amorphous cellulose may play a part, or the crystallites may intergrow. That the substances accompanying cellulose form to some extent the embedding

material between the crystallites (and this would supply an explanation of the dependence of artificial silk on the preliminary treatment of the cellulose) may perhaps be deduced by considering them as responsible for the low wet strength of artificial silk. They take up a large amount of water and allow the thread to "flow" when it is loaded. The cross-sections of artificial silk show that de-swelling and shrinking in the formation of the thread are considerably influenced by the previous history of the thread. A peculiarly constructed surface layer is always formed in a thread, and this has a greater strength and is less sensitive to water than the inner material.

Washing, Winding, &c.—In these processes, with which lustre and strength properties are closely related, de-swelling and drying are of great importance, but the processes have been little studied. Surveying the process as a whole, it would appear that an attempt is made to obtain the optimum particle size for viscosity and coagulation by the process of ageing, and that this particle size does not appreciably change throughout the process. In ripening, a certain degree of solvation is reached which is essential for the subsequent de-swelling and shrinking processes. Simultaneously, cohesion of the micellæ occurs and the micellæ by conversion to cellulose crystallites remain stable. This explains why fresh viscose gives an elastic thread and ripe viscose an inelastic thread. In the spinning bath, rate of coagulation, "cementing," and shrinking control the properties of the thread. —B.C.I.R.A.

Hydrolysis of Acetate Silk. R. Haller and A. Ruperti. *Leipzig Monats.*, 1925, **40**, p. 399.

Attempts to prepare a partially hydrolysed acetate silk of low acetyl content, by varying the conditions of hydrolysis, failed. The "partially hydrolysed" products were fully hydrolysed on the surface, and unchanged at the core. The swelling, optical, and dyeing properties of ordinary and hydrolysed Celanese are fully dealt with, with photomicrographs. Fully hydrolysed Celanese gives a blue colour with I_2 in $KI + H_2SO_4$ instead of the yellow obtained with ordinary celanese. —B.L.R.A.

Patents

Viscose Silk: Spinning. W. P. Dreaper, Hampstead Heath, London, W. E.P. 239,254.

Viscose silk, &c., of 5 deniers or even less, is made by spinning into a relatively dilute acid-salt bath containing 4-10% of a zinc salt, for example, zinc sulphate. A suitable bath contains from 18 to 32% of sodium sulphate or other salts, such as ammonium, magnesium, or other sulphate, preferably from 20-28% of these salts, and 9-13% of sulphuric acid, and it is convenient to work with such a bath at a temperature of 40-45° C. After leaving the bath the filaments may be treated in the funnel leading to the centrifugal box, with a solution of similar composition to that of the precipitating bath but of lower concentration, or with a solution not containing a zinc salt, or with water alone. —B.C.I.R.A.

Artificial Silk Spinning Device. B. Loewe, Zurich, Switzerland. E.P.239,255.

A spinning device for silk and artificial silk filaments comprising a tube formed with eyes and one or more discs rotatable about the tube is provided with a filament guide eccentrically mounted on the disc for polishing and evening the filaments. For artificial silk filaments, the tube is connected by a pipe, or a union and a cock, with the filament composition supply, and the filaments are led directly from eyes to guides on the disc, or through a lateral eye in the cavity beneath the disc. The cavity may contain a coagulating liquid or a liquid capable of absorbing the solvent, or air, heated if desired, may be passed through. A number of devices may be driven together, but they can be stopped individually. —B.C.I.R.A.

Hollow Artificial Filaments: Preparation. Courtaulds, Ltd., London, and H. D. Gardner, Wallington, Surrey, E.P. 239,622.

Hollow artificial threads or filaments are made by projecting a solution of a cellulose ester, other than viscose, in a solvent miscible with water, into an aqueous precipitating bath, the duration of the immersion of the filaments in the bath being longer than is necessary to give lustrous solid filaments, for example, by increasing the length of travel of the filament in the bath. Thus, solutions of cellulose acetate in acetic acid or acetone are projected into water, dilute acetic acid, sodium acetate, and sulphate solutions, or a solution of sodium carbonate and hydrate. —B.C.I.R.A.

Cottonised Fibre: Preparation. B. P. von Ehrenthal, Cöthen-Anhalt, Germany, and K. Scholz, Tetschen-on-Elbe, Czechoslovakia. E.P.239,722.

In obtaining cottonised fibre from hemp, flax, nettles, and the like, the suitably prepared material is squeezed or beaten and simultaneously treated with warm or cold water or liquids, such as soda lye. It is then stretched whilst wet in a cold or warm condition, whereby the individual cells are extracted from the cell conglomeration, separated, and the incrustations and adhesive substance removed in a warm or cold condition by jets of water directed against one or both sides of the fibres in fleece form. The cottonised fibrous cells so obtained may be dried, or first bleached, impregnated, roughened,

dyed, or otherwise treated in known manner. The stretching may be effected by usual drawing rollers which may be immersed in liquid, or the first pair of rollers may be replaced by a drum having a step feed and provided at its periphery with movable bars co-operating with a ram moved up and down by a cam. The jets of water may be applied to the fleece by hollow rollers having inclined slots.

—B.C.I.R.A.

Cellulose Esters: Preparation. Farbenfabriken vorm. F. Bayer & Co., Leverkusen, Germany. E.P.239,726.

Esters of cellulose, starch, sugars, and other carbo-hydrates, with the higher unsaturated fatty acids, are prepared by treating the carbo-hydrates with the acid chloride of the fatty acid. Suitable fatty acids are oleic acid, linoleic acid, linolenic acid, and the unsaturated acids of train oils. Examples are given of the preparation of the linolenic acid ester of cane sugar, potato starch, soluble starch, hydrocellulose, cellulose, and grape sugar, the carbohydrate being heated with the acid chloride in the presence of pyridine or dimethylaniline. The products are viscous or limpid oils which are soluble in hydrocarbons, oils, turpentine, &c., and are suitable as substitutes for drying oils and in the preparation or manufacture of varnishes, artificial threads, films, plastic compositions, &c.

—B.C.I.R.A.

Viscose Filaments: Preparation. H. Hawlik, Berlin, Germany. E.P.240,487.

Cadmium compounds are added to the acid baths used for the precipitation of viscose filaments, films, &c. Filaments thus obtained show a high lustre, greater strength, and a good covering capacity. Small additions of cadmium compounds suffice, and it is possible to spin the finest threads. Examples are given of baths containing cadmium, magnesium, and sodium sulphates, and sulphuric acid, with and without glucose, and cadmium and sodium sulphates and sulphuric acid.

—B.C.I.R.A.

Cellulose Acetate: Preparation. L. A. Levy, Cricklewood, London. E.P. 240,624.

Acetone-soluble cellulose acetates are produced by adding to the acetylating mixture comprising a condensing agent, a salt or salts of vanadium, nickel, cobalt, or chromium. The addition has the function of a catalyst, the metal being the active element, and therefore it may be introduced in the metallic form, passing gradually into solution as the reaction proceeds. In examples, chromium acetate is added from the commencement and the temperature is first kept below 15° C. until solution occurs, and is subsequently maintained at 30° C. until an acetone-soluble acetate is produced. Alternatively, nickel acetate is present during the first stage and an addition of vanadium sulphate is made before the temperature is raised to 30° C. The material treated is preferably cotton in the form of paper and containing 6-7% of moisture. During the first stage of the reaction the temperature may be controlled by occasional additions of sodium carbonate in order partly to neutralise the sulphuric acid employed as condensing agent. The Provisional Specification refers to the addition of salts of aluminium, copper, and magnesium as catalyst.

—B.C.I.R.A.

Viscose Silk: Spinning. Herminghaus and Co. and L. Hesse, Vohwinkel, and H. Rathert, Elbefeld, Germany. E.P. 240,717.

For spinning artificial silk, more particularly the finer grades of 5-2 deniers or lower, a viscose prepared from a ripened alkali-cellulose is employed in which in the preparation of the alkali-cellulose and in the further operations up to spinning, the action of atmospheric oxygen is prevented or minimised as by the addition of a reducing agent, such as sodium sulphite, or by conducting the operations in the presence of a reducing or inert gas, such as illuminating gas, hydrogen, or nitrogen, but excluding the employment of a vacuum. The precipitating bath employed consists of a solution of sodium sulphite containing a proportion of acid. Using a viscose prepared as above it is possible to prepare all sizes of silk with one type of precipitating bath, nor is it necessary that the ripeness should be adjusted within fine limits. Some examples are quoted.

—B.C.I.R.A.

Cellulose Derivatives: Preparation. L. Lilienfeld, Zeltgasse, Vienna. E.P. 241,149.

Cellulose derivatives are prepared by allowing an ester of an inorganic acid to act on a salt of a N-substituted or an unsubstituted cellulose thiourethane, or alternatively on these substances in the presence of a basic substance, particularly an alkali. The products are insoluble in water; some are soluble in basic solvents, such as aqueous alkalis and aqueous solutions of pyridine or organic amines, others are soluble in aqueous alkalis, aqueous solutions of organic bases, and in organic solvents, whilst others are insoluble in aqueous alkalis but dissolve in a wide range of organic solvents. The solubility of the product depends on the working conditions and particularly on the nature and proportion of the inorganic acid ester employed. Suitable inorganic acid esters are the allyl, aryl, and aralkyl halides, sulphuric acid or phosphoric acid esters, and the esters may be diluted with a solvent. Details of the method are given.

—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Production of Artificial Fibres—

239,304. I.P.M. Syndicate, Ltd., and W. Bacon. Hydration of Fibrous Cellulose.

241,190. O. Kohorn & Co. Spinning machine: driving gear device.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Drawing Machines for Worsted Yarns. Freisler. *Melliand's Textilberichte*, 1925, **6**, 484 and 561.

A paper describing in detail the can gill box and fly frame with gill box drawing, and the processes of working the same. Tables are given showing the dimensions, speeds, &c., of the preliminary, intermediate, and four finishing drawing frames, especially suitable for 60's botany and crossbred wools. —B.R.A.W. and W.I.

The Breaking of Rovings in Carding. *Melliand's Textilberichte*, 1925, **6**, 229.

It is stated that this defect is mostly due to the machines themselves, and not to the temperature as is often assumed. Proper adjustment and regular examination of the clearer and worker, which should always be well ground, and close observation of the fly-comb and doffer, are necessary. Care must also be taken that the tape leathers do not slip or get hard.

—B.R.A.W. and W.I.

Burring Motion for Cards. *Melliand's Textilberichte*, 1925, **6**, 331.

The apparatus is built by Klein, Hundt and Co., Dusseldorf, and is supplied, either fixed to a carder or separately. Saw-toothed feed rollers bring the wool to the first burring roller, where all hard impurities are removed by a clearer. A licker-in then carries the material to a group of rollers, working like hackles, and from there a circular brush takes it to a second saw-toothed burring roller, which is also provided with a clearer. The great advantage is that the burrs are removed unbroken and almost free from wool, and that the wool remains undamaged and its staple unchanged. —B.R.A.W. and W.I.

Cards for Sorting Out Short Fibres. A. B., *Rev. Textile*, 1925, **23**, 1137-1141.

The invention described is to enable cards for cotton to effect a sorting out of fibres below a certain length, thereby increasing the value of the carded fibre by reason of the greater regularity of yarns spun from it. The essential principle is the addition to the card of two or more rollers of suitable speed, setting, and pinning. The first roller receives the fibre, and its speed is sufficiently great for it to throw off by centrifugal force the short fibres, which drop into a container. The longer fibres are doffed by the second roller, which can either effect a second sorting or return the fibre to the drum from which the first roller received it. Various other arrangements are also described and illustrated.

—L.I.R.A.

Lefebvre High-Draft System. A. Schmidt. *Rev. Textile*, 1924, **22**, 551.

The Lefebvre system is stated by the inventor to consist in a special and mechanical adjustment of the machines of preparation, from opener to fly-frame, in such a way as to obtain in practice a very regular roving. To this alone is ascribed the possibility of doubling or trebling the draft normally employed. The advantages claimed for the system are enumerated, and it is stated that within fifteen months it was in use in forty French mills representing over 1,200,000 spindles.

—B.C.I.R.A.

Ball Bearing Spindle. J. D. Clad. *Rev. Textile*, 1924, **22**, 431.

The article shows that it is possible to replace the pivot bearing of a spindle by a ball bearing, and thus to obtain all the advantages attendant generally on the use of ball bearings. Results of tests made with pivoted spindles, with and without lubrication, and with spindles mounted on ball bearings, show comparatively the saving in motive force afforded by the latter. —B.C.I.R.A.

Combing Machines: Output. E. Maurer. *Rev. Textile*, 1924, **22**, 335-339.

The author discusses the mechanism of the cotton comber, and shows that output is directly proportional to length of hair to be combed, number of nips per unit time, and to weight per unit length of the sliver fed in. He discusses the means of increasing the last two variable factors, but points out the great number of details to be considered, of which there appears to be little accurate knowledge. To cite only a few important factors are—number of needle bars and type of needles, inclination of needles, thickness and regularity of the feed lap, distance between lip of upper jaw and needle points, strength and speed of nip, type of feed rollers, &c. The author calls attention to the almost entire lack of literature on the subject of combing machines, even of the Heilmann and other commonly used types. —B.C.I.R.A.

(B)—Spinning and Doubling

Mule Roller Motion: Advantages. M. Rimette. *Rev. Textile*, 1924, **22**, 341.

In view of different opinions regarding the advantage afforded by roller-motion to make up the decrease in length consequent on twisting, the author arrives at a simple expression for the difference in weight of

spun yarn obtained in a given time from a frame by employment and non-employment of roller motion. In an illustration from measurements of a 600-spindle frame the additional weight obtained was of the order of 5 kilos. a week. From the expression it is also clear that a roller-motion delivery of X cms. of roving represents a gain in length of ½ X cms. of yarn.

—B.C.I.R.A.

"Houget" Spinning Frame. *Rev. Textile*, 1924, **22**, 235-241.

The article describes the newly-developed self-acting mule frame designed by Houget, of Verviers, in which the spindle carriage is stationary while to and fro motion is imparted to the feed bobbins. The new frame is described as having many advantages, notably as regards output and efficiency, over the ordinary type of self-acting frame; and it is claimed that with the bobbin carriage firmly fixed the speed of the spindles can be greatly increased without risk of vibration. In the Houget frame the spindles can be actuated at three different speeds. The constructional details for obtaining uniform motion of the feed bobbins and all the other advantages of the frame are described.

—B.C.I.R.A.

Effect of Neolan Dyestuffs on Spinning Property. See Section 41.

(C)—Subsequent Processes

Reeling Swift. Bruegger et Cie. *Rev. Textile*, 1924, **22**, 433.

An improved form of swift for winding off raw or degummed silk, cotton wool, &c., is described. The eight arms of the winder are constructed in flexible steel wire; they are adjustable in length, but can be clamped rigidly in any desired position. The length is altered by rotating the disc in which the bearing is situated. The instrument is light and rigid, and applies an even tension to the thread wound on it.

—B.C.I.R.A.

Reeling Swift. A. Helle-Staux. *Rev. Textile*, 1924, **22**, 559-561.

An improved form of apparatus for unwinding raw silk, &c., made by Bruegger and Co., is described. The device is designed to ensure winding at equal tension, the speed can be varied from 70 to 240 metres of thread per minute, and the thread-guide is fork-shaped and arranged so as to minimise fraying of the thread.

—B.C.I.R.A.

(D)—Yarns and Cords

Jute Yarns; The Strength of Single and Double Carded——. H. Rudolph. *Leipsiger Monats.*, 1925, **40**, 375-377.

The investigations described show that at the critical degree of twist, jute yarns which have received a single carding treatment have from 2% to 10% higher breaking length than corresponding yarns which have received a double carding treatment. Further, 5% to 15% higher production is possible with the single carding. The extension of the yarn is approximately the same in both cases. The torsion test confirms the supposition that the fibrous material is better preserved and that the average fibre length is greater with the single carding treatment.

—L.I.R.A.

Yarn Twist: Effect on Fabric Appearance. *L'Avenir Text.*, 1925, **7**, No. 8, pp. 374-376 (from *Industria Tessile et Tintoria*).

A general consideration of the effect of the degree and direction of twist in yarns on the appearance of woven fabrics.

—B.C.I.R.A.

Yarns; Investigation on the Connection between Strength and Twist in Jute——. H. Rudolph. *Melliand's Textilberichte*, 1925, **6**, 688.

The author continues the description of his work on strength and twist in jute yarns. Thirty test pieces were taken from each bobbin, 300 test pieces being broken for every point on the breaking tension curves. The curves shown include those showing the relation between twist and strength, twist and breaking length, and twist and extension.

—L.I.R.A.

Jute Yarn; Investigation on the Relation between Strength and Twisting of——. H. Rudolph. *Melliand's Textilberichte*, 1925, **6**, 770-771.

The author summarises the results of investigations, which have been presented in graphical form in earlier contributions. The extension properties of jute yarn have been shown to vary greatly with the degree and regularity of twist. The yarn strength has been shown to depend on the twist, the quality of the raw material, and the working treatment. The critical twist coefficient for metric number, i.e., that for highest breaking strength, has been found to be 0·87, which corresponds to a breaking length of about 10·29 km.

—L.I.R.A.

Patents

Artificial Wool from Jute. N. Thomann. F.P.584,643.

A bath containing aqueous solution of caustic soda 14-16° Bé. is prepared. Sodium sulphuret is added in proportion of 1 kg. to 100 kg. of raw jute. This is immersed in the bath until light curlings are produced on the fibres. The goods are washed and afterwards immersed in a diluted sulphuric solution of 1° to 2° Bé. for ¼ hour. The goods are then dried and carded.

—Bur. Text.

Improvements to Curvilinear Combing Machines. F. Lorthiois à Roubaix. F.P. 584,658.

This patent comprises a brush, a comber, and a beating comb. Upon the brush is wound a leather band bearing the bristles of the brush. This corresponds with the shape of the bars. On the comber is wound a band of india-rubber linen furnished with steel needles, the shape of which is similar to those of the cards which correspond with the shape of the brush. The metallic comb is driven by a cam. The brush turns in a contrary direction to the needles of the bars and at a superior speed. —Bur. Text.

Stop Motion for Balling Machine. Société Bauché et Wadenklee. F.P.584,708.

By this patent the spindle stop, when the ball is full, is bound to a device for disengaging the spindle, for cutting the yarn, and for ejecting the balls. After the spindle is stopped, this is automatically drawn out of the ball, the yarn is cut, and the ball ejected. The drawing of the spindle out of the ball is obtained by means of a draw needle charged by a counterweight. —Bur. Text.

Cocoon Dropping Apparatus for use in Silk-reeling Machines. K. Kobori and R. Naito. U.S.P.1,517,366 (from *Textile Colorist*, 1925, **47**, No. 554, p. 121).

A rotatable disc with recesses on the rim for cocoons, and a guide tube to bring the cocoons to the recesses; a filament supplier is arranged below the guide tube and an arrangement for advancing the disc while working. —F.G.P.

Device for Preventing the Adhesion of Raw Silk at Reel Angles. R. Naito. U.S.P. 1,531,343 (from *Text. Colorist*, 1925, **47**, No. 558, p. 395).

The members of the reel are hollow, and the silk thread on leaving the basin passes through a tube into which air is driven from a fan and heated. The object is to prevent gum tacks. —F.G.P.

High Draft Systems. A. Schmitt. *Rev. Textile*, 1924, **22**, 219-223.

In continuation of his historical sketch of roller-drafting inventions, the author describes certain recent patents relating to draft-rollers and high-drafting systems. Briefly summarised the inventions are as follows—

(1) French patent 560,535 of 1923 (Rieter). In order to reduce the number of free hairs in the length of roving between the second and third pairs of rollers in the ordinary high-drafting system, the inventors seek to decrease the distance between the feed and delivery rollers to the order of the length of the hair (42 mm.). In this position it is impossible to draw rovings having the ordinary twist conferred by the fly-frame, and the twist is therefore diminished by employing a pair of weighted rollers at the requisite distance (42 mm.) from the original feed rollers. Alternatively, a combination of weighted and guide rollers may be employed for the same purpose. The objection to this system (as pointed out by Casablancas) is that the final roving is too open, the hairs having become spread out in the drafting process.

(2) French patent 564,437 of 1923 (A. Schmitt). The distance between delivery and intermediate roller is 17 mm. and the three cylinders are in an almost horizontal position. The leather cover of the top weighted roller is replaced by a band kept in position by another roller, and so arranged to draw and deliver the roving to the spindle in a vertical direction instead of, as is usual, inclined at an angle. By the action of the band it is sought to overcome the spreading of the roving and the consequent detachment of individual hairs. Also the vertical feed to the spindle has advantages over the inclined feed. In practice the important thing is to design a good band for the roller. —B.C.I.R.A.

Spinning Frame Roller Head. O. Elliott, Blackburn, Lancs. E.P.239,367.

A detachable plate is secured to the cap bar of ring spinning frames to form the front of the bearing for the back rollers, so that it may be replaced when worn. The Provisional Specification describes a detachable part, T-shape in plan, adapted to be secured by screws in a recess in the top of the cap bar. —B.C.I.R.A.

Artificial Silk Bobbin Washing Machine. B. Borzykowski, Neuilly-sur-Seine, France. E.P.239,482.

Artificial silk wound on perforated bobbins having closed ends is washed by immersion in a tank, a pipe passing through one of the closed ends communicating with suction or vacuum. Two or more bobbins may be placed on one another, perforated spacers closing the space below them.

—B.C.I.R.A.

Textile Fibres: Preparation for Spinning. L. Ubbelohde, Baden, Germany. E.P. 239,605.

The process of Specification 193,373, according to which fibres are roughened before spinning by treatment with sharp edged material, such as glass powder, is extended to the treatment of kapok, artificial silk, and staple spinning fibres, such as cotton and wool. —B.C.I.R.A.

Card Flat Cleaning Device. R. W. Norris, Stalybridge, Cheshire. E.P.239,608.

The fly, &c., is removed from the flats of carding engines by positively rotating brushes with their axes at right angles to the length of the flat, which are traversed along the flat and are cleared by another brush from the surface of which the fly,

&c., is taken away through a conduit by suction. Mechanical details are given.
—B.C.I.R.A.

Cotton Opener Cage. J. Bancroft and Howard & Bullough, Ltd., Accrington, Lancs. E.P.239,658.

The exhaust cage of an opener or cleaner for cotton, &c., is provided with an internal plate shaped to give an air passage of minimum area at the centre and of maximum area at the sides where the cage connects to the ducts leading to the exhaust fan, so as to secure a uniform flow of air over the whole of the width of the cage. The plate can be moved inside the cage to alter its position circumferentially relatively to the cage. —B.C.I.R.A.

Drawing Frame Stop Motion. S. Robinson, Failsworth, Manchester. E.P.239,699.

In a full can stop-motion for a drawing frame the peg, which is lifted into the path of the usual reciprocating bar, is drilled and tapped and fitted with a screw which can be turned to adjust the length of the peg as it wears. A lock-nut secures the screw in position. —B.C.I.R.A.

Carding Engine Feed Device. F. Bohle, Werdau, Saxony. E.P.239,757.

In a feeding device for cotton carding engines of the kind described in Specification 232,542, the scutched lap is fed by a roller to a comb with blades which deposits the material in a scale. A roller is provided over the feed plate. The scutched lap may be fed forward between two feed rollers, the lower one co-operating with a trough. —B.C.I.R.A.

Roller Drawing Head. A. M. Sacasas, Manresa, Spain. E.P.240,028.

In a drawing mechanism for machines for preparing and spinning cotton, wherein two pressure rollers co-operate with the lower intermediate roller, the pressure rollers are geared with the lower intermediate roller and are weighted by saddles connected to a weight lever by a rod. One saddle bears on the front top roller.
—B.C.I.R.A.

Bobbin Braking Device. A. H. Stott, Mobberley, Cheshire. E.P.240,060.

A device for braking bobbins in winding machines and in warping or other creels comprises a looped suspended friction band which engages and supports a pulley fixed on the bobbin or on the spindle. The other end of the bobbin or spindle is either supported in a fixed bearing or in a similar looped band, in which latter case the second pulley must be adjustable to allow of removal of the bobbin. The spindles are supported laterally by guides attached to the uprights which carry the loop suspension. —B.C.I.R.A.

Spinning Frame Yarn Friction Surfaces. E. Gminder, Reutlingen, Germany. E.P. 240,193.

In spinning cotton, a roving produced in a flyer frame is subjected to the action of a surface arranged between the first and second pair of drawing rollers in the system illustrated and moving transversely with regard to the roving in a direction opposite to the direction of twist. This action tends to loosen the twist. A second surface placed in front of the delivery rollers moves in the direction of the twist, so as to tend to transmit the twist imparted by the spindles up to the nip of the front rollers. Guides are provided to prevent undue transverse motion of the yarn.
—B.C.I.R.A.

Spindle Mechanism. H. Deppermann, Nowawes, near Berlin, Germany. E.P. 240,450.

In spinning frames with overhead driven flyers, the bobbin is rigidly connected, as by a spring, to the spindle, which is rotatably mounted in ball bearings and carries a drag pulley. The drag arrangements are enclosed within a space formed by the lifter plate or frame, and a casing so as to be protected from dust and water, and are located between the frame and its shaft, or beneath the frame and level with the shaft when the axis of the shaft is laterally displaced from the axis of the flyer. The drag cord is secured at one end to an eye and at the other to resilient means. Guide rods mounted on ball bearings are provided for the length of yarn extending from the full to the empty bobbins. The spring is provided with a catch which engages a recess in the bobbin, so as to prevent it from falling when the frame is rotated.
—B.C.I.R.A.

Roving Frame Roller Head. L. Hemsley and J. Hetherington & Sons, Ltd., Ancoats, Manchester. E.P.240,671.

In roving and like frames, in which two sets of drawing rollers are provided with a false twist mechanism between them, the false twist is imparted to the slivers by means of flyers comprising tubes and pulleys provided with eyes. The flyers of each box are driven by an endless band from pulleys connected by chain gearing. The tubes of the flyers may be stationary, the pulleys carrying the eyes only being rotated. —B.C.I.R.A.

Spindle Apparatus. W. Freund, Chemnitz, Germany. E.P.241,073.

In spindle apparatus of the kind in which a cap is slidably mounted on the spindle and the yarn passes between the lower edge of the cap and its support, the cap is supported on balls or rollers mounted in a single row or in two staggered rows in a cage in the lifter rail. The cage may be rotated in the same or opposite direction to the spindle, the cap being held stationary,

or the cap and cage may be held stationary and only the spindle rotated. The cap is provided with a detachable rim which may be exchanged to suit the material being spun. The cage may be secured in the rail by means of a split holder, and preferably comprises a flanged ring screwed on to a supporting ring, spaces being formed between the rings to allow the escape of dust. The cap is provided with detachable weights to vary the friction exerted on the yarn. —B.C.I.R.A.

Spindle Driving Apparatus. J. J. Keyser, Aarau, Switzerland. E.P.241,127.

A gear ring which meshes with a worm on the spindle is rotated by friction between the inner periphery of the ring and a sleeve fast on the actuating shaft. This frictional connection is effected by coil springs located in recesses formed either in the gear ring or in the sleeve. A split ring is preferably interposed between the springs and the sleeve or the gear ring. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Preparation for Spinning—

239,324. P. & C. Garnett, Ltd., and C. W. I. Leather. Feeding device for rag-pulling machine.

239,481. Textile et Filature. Kapok carding engine.

239,495. Fabricord Associates. Flax breaking and scutching machine.

239,713. A. W. and P. Nootenboom. Curling or twisting process for fibres and hairs.

239,967. J. Haigh & Sons, and A. Riley. Tape condenser.

240,280. D. Ballantyne Bros. & Co. Ltd. Single doffer carding engine.

240,786. Fabricord Inc. Breaking and scutching device for hemp, &c.

Spinning—

239,659. W. and M. Gaskell. Spinning horsehair yarns.

240,058. T. Whitehead. Ring spinning spindle drive.

240,119. P. Salles. Device to secure cops on spindles.

240,530. A. L. Benson. Roller bearings for flax drawing frames.

240,531. C. T. Gordon. Draw frame sliver conductor: traversing mechanism.

240,777. B. Loewe. Belt gearing for spindle driving.

241,125. M. Meinke. Hand spinning or doubling frame.

Winding—

240,135. H. C. Stuhlmann. Reel for winding hanks.

240,787. Cynthia Mills. Preparation of package of wound yarn.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Shoddy Manufacture: Carbonising. *Melliand's Textilberichte*, 1925, **6**, 653.

An illustrated review of machinery made by Messrs. Shirp, Vohwinkel (Rhld.), suitable for the manufacture of shoddy. On their carbonising drum complete carbonisation is obtained with 6%-8% hydrochloric acid of 20°-21° Bé. Preliminary drying and carbonising take place in the same drum, the process being 30%-40% cheaper than wet carbonisation. The output of the shaker described varies from 8-10,000 kg. in 10 hours, and in their double-armed washer neutralisation takes place at the same time. A dyeing apparatus, several drying machines, and the Shirp rag teaser are also described. —B.R.A.W. & W.I.

(B)—Sizing

Starch Solution: Preparation. P. Petit. *Compt. Rend.*, 1925, **181**, 259-260.

A note of a method of preparing a clear solution of starch by adding to 150 grms. of 2% starch paste a solution containing 7 mg. of sodium chloride, 5 mg. of monopotassium phosphate, and 2 mg. of lactic acid, under very carefully controlled conditions. The clarification is apparently assisted by the presence of silica. The product filters slowly through paper and gives the common reactions of starch. —B.C.I.R.A.

Prevention of Mildew in Yarn Dressings. See Section 3G.

(C)—Weaving

Artificial Silk: Weaving. F. Müller. *Kunstseide*, 1925, **7**, 141-144 and 198-202.

Notes on washing fabrics made of cotton warp and artificial silk weft, and on the weaving of fabrics in which artificial silk can be utilised with advantage on account of its relative cheapness. Particulars are given of the necessary loom adjustments and methods of warping. The conditions necessary for the substitution of artificial silk warp for natural silk warp in weaving materials for linings, using a double shed jacquard, are described in detail. —B.C.I.R.A.

Artificial Silk Mixed Fabrics: Weaving. F. Schultz. *Kunstseide*, 1925, **7**, 5-6.

A note on the application of artificial silk in weaving with descriptions of (1) a fabric with linen warp, artificial silk weft, (2) an artificial silk warp and crepon thread weft of artificial silk, and (3) an artificial silk warp and worsted weft, used in Ottoman type fabrics. —B.C.I.R.A.

Hattersley Dobby. G. Steiner. *Melliand's Textilberichte*, 1925, **6**, 11-13, 84-85, 406-409, and 488-491.

A general account of the development, construction, and operation of the Hattersley dobby. —B.C.I.R.A.

A New Shuttle-driving Device. P. Beckers. *Leipsiger Monats.*, 1925, **40**, 388-389.

A mathematical discussion of the energy requirements with the usual pick method of shuttle driving is given. This is followed by a description, with diagrams of the Souczek patent shuttle drive, which was shown at the machine exhibition at the Twelfth International Cotton Congress in Vienna. The principle of the Souczek patent is that at the end of a shot, the shuttle meets spring resistance, which reverses its direction of motion. It then meets the surface of a rapidly rotating drum, which has moved upwards during the reversal of shuttle motion. The drum imparts to the shuttle the increase in velocity necessary for next shot.

—L.I.R.A.

Small-ware Loom Take-up Apparatus. Servy Frères. *Rev. Textile*, 1924, **22**, 581.

A special form of apparatus for taking ribbons, elastics, and other narrow fabrics off the loom. To ensure even winding, tension is applied to the fabric, the degree of tension being varied according to the weight, &c., of the material concerned.

—B.C.I.R.A.

Jacquard Mechanism. *Rev. Textile*, 1924, **22**, 569-571.

A device for securing more regular motion of the card of a Jacquard mechanism by improving the method of detaching the card from the cylinder. Each end of the cylinder, at the position of its contact with the spring, is provided with a pair of discs mounted on a cross bar of slightly greater length than the diameter of the cylinder and free to move in a groove across the axis of the cylinder in such a way that when the cylinder is rotating and one disc arrives under the spring, the opposite disc is depressed and projects a short distance beyond the surface of the cylinder, thus imparting a downward push to the card, which is already being detached from the cylinder by the action of gravity.

—B.C.I.R.A.

Cut Weft Fabric Selvage: Weaving. *Rev. Textile*, 1924, **22**, 365-369.

A new method of putting a selvage on to a fabric having an irregular selvage due to the employment of cut wefts in weaving. In principle the new selvage consists in inter-lacing a series of loops of warp thread with the original selvage warp, the loops serving to bind the latter and prevent it from paying out. The mechanism of the device for forming the loop selvage is described with illustrations.

—B.C.I.R.A.

Non-extensible Spindle Bands: Weaving. E. Ries. *Rev. Textile*, 1924, **22**, 135.

A description of an improved loom for plaiting spindle bands, candle wicks, fishing-net cord, &c. It is fitted with a cone mechanism for ensuring regularity of tension in the threads fed in. The tension on the threads being uniform the spindle band formed from them possesses the necessary elasticity. The loom produces in 12 hours a length sufficient for 1,200 spindle bands. On account of the importance of non-extensibility of the spindle band during spinning or doubling for securing regularity of tension and strength in the resulting yarn, Ries has introduced a machine for stretching the spindle band. By means of the mechanism the spindle band, which has first been wetted, is stretched and then wound wet on a brass bobbin. When full the bobbins are dried and the band employed just as before. The bands retain elasticity and, not being able to stretch further, they impart much more uniform motion to the spindle.

—B.C.I.R.A.

Hand Loom Dobby Mechanism. E. Acheray. *L'Avenir Text.*, 1925, **7**, No. 8, pp. 368-371.

Automatic dobby mechanism for controlling the shedding of the warp in hand looms is described. —B.C.I.R.A.

Ribbon Loom. A. Saurer, Soc. Anon. *L'Avenir Textile*, 1925, **7**, 273-275.

A new single reeding ribbon loom manufactured by Saurer is described. The advantage claimed for the single reed loom over the multiple reed loom is that different ribbons may be woven at each reed, different as regards width, design of warp and weft, and nature of material employed, cotton, silk, &c. The output of the new loom is claimed to be considerably higher than that of multiple reed looms. The particular constructional improvements of the Saurer loom are outlined in the article.

—B.C.I.R.A.

Common Weaving Faults. See Section 6.

Loom Driving Motor. See Section 7C.

Air-conditioning for Weaving. See Section 7H.

(F)—Subsequent Processes

Prevention of Mildew. P. Straszewski. *Melliand's Textilberichte*, 1925, **6**, 497.

A critical review of all organic and inorganic antiseptics, which shows that the only reliable preventatives against mildew on dressings and fabrics are salicylic acid and its derivatives, and also formaldehyde. The latter has recently been substituted by the less volatile para-formaldehyde.

—B.R.A.W. & W.I.

Mildew Prevention. Feibelmann. *Melliand's Textilberichte*, 1925, **6**, 586.

An adverse criticism of a paper by Straszewski (*Melliand's Textilber.*, 1925, **6**, 497), in which salicylic acid, formaldehyde, and para-formaldehyde were claimed to be the only reliable preventatives against mildew. The writer describes the excellent antiseptic properties of "Activin," a neutral colourless substance, which is soluble in water, stable, non-poisonous, and does not deteriorate fibres. It also hydrolyses starch, thus abolishing the use of a second antiseptic in finishing baths. Further, he states that formaldehyde is useless in sizing baths, as it precipitates protein from sizes. —B.R.A.W. & W.I.

(G)—Fabrics

Double-face Cloth. R. Sommer. *Rev. Textile*, 1924, **22**, 577.

A reversible fabric is made by felting together on a woven or net base two different cloths which may consist of (*a*) wool, (*b*) wool and carded cotton, &c. —B.C.I.R.A.

Cane Trunk Fabric. *Melliand's Textilberichte*, 1925, **6**, 491-492.

A double fabric having canes inserted in pockets between the front and back of the fabric is described. The fabric is intended for making trunks, &c.; it has the same appearance on both sides and it can be manufactured on ordinary change-box looms of heavy construction. —B.C.I.R.A.

Shoddy Manufacture. See Section 3A.

Patents

Electric Jacquard. Société Burtin et Girard. F.P.584,346.

Designs to weave are painted on an endless cylinder or chain by means of a metallic varnish conducting electricity. The ground of the cloth is represented by insulated parts. The position of each hook is determined by a push-needle, the motions of which depend both on the position of the grid and of the electric disposal in relation to points in contact with the designs on the endless cylinder. —Bur. Text.

Knitting with Weft Yarn. G. Sarti. F.P. 584,802.

This patent refers to a device for inserting a weft yarn into knitted goods characterised by the previous lifting of a certain number of needles on which is laid the weft yarn and the subsequent lifting of the other needles, so that these latter pass in their rising motion on the other side of the yarn, the lifting of the needles being such that the inserted yarn goes beyond the lappets of the needles, so that it is not knitted. —Bur. Text.

Pile Fabric Loom Tube Frame carrying Chains. Platt Bros. & Co. Ltd., and F. W. Austin, Oldham, Lancs. E.P. 239,250.

Means are described for guiding and driving the tube-frame carrying chains which carry tube frames to and from the place where the tube frames are removed from the chains for insertion of tuft yarns into the fabric being woven, and are then returned to the chains, the chains being held stationary at this place from time to time for this purpose. —B.C.I.R.A.

Knitted Fabrics: Structure. G. Sarti, Etterbeck, Brussels. E.P.239,261.

Unknitted warp threads, with or without weft threads, are included in a knitted fabric. The wefts may be elastic or otherwise. The fabric may be made flat or tubular and ribbed or plain. The warp threads may be imprisoned by the double loops of a plated fabric, and may be suppressed at intervals to leave passages in the cloth. Tubular fabrics of this kind are made on a machine with a revolving needle-cylinder fitted with long and short butt latch needles arranged alternately. After a row has been knitted the long butt needles are first lifted by an amount sufficient to allow a weft thread to be laid in their hooks and the short butt needles are then lifted. Similar fabrics and also ribbed fabrics with warps or warps and wefts are knitted by using one or both needle beds. —B.C.I.R.A.

Knitting Machine Knot-tying Mechanism. W. Spiers, XL Works, Leicester. E.P. 239,268.

The patent relates to yarn feeding, changing, and knot-tying devices for use particularly in machines of the superposed cylinder type, as described in Specifications 15,008/00 and 24,290/12. The yarns are led to corresponding fingers from which one yarn proceeds to the needles whilst the others are held by trapping members. The running yarn travels upwards in front of a fixed guide plate to a non-movable mounted knot-tying device, which may be of the type described in Specifications 18,778/00 and 2,311/03, and thence to the needles. To change the yarn one finger is operated to bring its yarn into the path of a looper element. The V-shaped yarn-receiving end then places both yarns across the tying bill and the clamping elements. An extension on another guide plate deflects the yarns behind the blades of the bill. Meanwhile the looper element throws one yarn behind the fixed guide plate, whilst the other yarn is brought between two guide plates. The bill now rotates to form the knot, the ends of yarn are cut, and as the bill approaches the end of its movement, the loops are stripped from it whilst the joined yarns remain in the clamp to enable the knot to be tightened —B.C.I.R.A.

Shuttle Checking Mechanism. N. Catterall, Dunscar, near Bolton, Lancs. E.P. 239,343.

The bunter arm carried by the slay connecting rod and acting on a spring to vary the pressure of the swell on a shuttle in the shuttle box is curved and has a slotted end so that it can be adjusted in two directions at right angles on its slotted holding bracket, and secured after adjustment by a single bolt. The stirrup on the bolt has bent-down ends to engage the edges of the bunter arm, and these ends have central projections passing into the slot of the bracket. The bracket is secured to the connecting rod by bolts, one of which passes through a curved slot in the bracket. The swell spring is extended into the path of the bunter arm and fitted with an adjusting bolt near its fixed end, which also serves for securing the end of the check strap. —B.C.I.R.A.

Pile Fabric Loom. E. Hollingworth (Dobcross Loom Works), Dobcross, Yorks. E.P.239,344.

In a loom for weaving chenille, Axminster carpets, blankets, &c., having plain parts and parts comprising chenille weft, and in which there are two or more shifting shuttle boxes at each end of the lay, the top shuttle boxes are brought into line with the raceway, the shuttle box operating levers are held out of action, the rate of take-up is increased, and the starting handle is prevented from "locking" in the starting position, so that the loom is stopped after every pick, while chenille weft is being woven in. The shuttle boxes are connected by flexible chains to levers controlled by springs and cams, the boxes being lowered when the cams actuate the levers. —B.C.I.R.A.

Loom Dobby Mechanism. F., and A. Fielden, Heaton Moor, Cheshire. E.P. 239,411.

A lever which carries the body and border pattern lag barrels is controlled by the action of the dobby lever on a triangular lever, which is positioned by a further pattern lag. A system of levers is operated to position the triangular lever so that the dobby lever acts upon one side or other of the apex thereof. —B.C.I.R.A.

Woven Fabric: Construction. Burgess, Ledward & Co. Ltd., and J. Crompton, Manchester. E.P.239,419.

Ornamental woven fabrics, resembling knitted fabrics, are produced by using two or more thick or coarse yarns, preferably of gimp, between successive fine yarns of cotton and/or worsted, &c., in the warp and interweaving therewith cotton and/or worsted or wool wefts, and silk or artificial silk wefts, which are floated in places over the coarse yarns to form prominent loops, whilst at other places they form a plain weave with these threads or float under them. The silk or artificial silk wefts may float over alternate groups of the coarse threads or over successive groups. Two picks of the silk and two picks of the cotton, worsted, or wool wefts may be inserted successively. The cotton and/or worsted or wool wefts form a plain weave with the whole of the warp threads. —B.C.I.R.A.

Knitting Machine Stop Motion. F. Billson and C. S. Stirland, West Bridgford, Nottingham. E.P.239,629.

The breakage or excessive tension of a yarn or the occurrence of a hole in the fabric made on a multi-feed machine with a rotary needle cylinder, causes a universally jointed arm to drop between the teeth of a continuously rotating wheel. The arm thus moved about a vertical pivot comes into contact with an abutment and moves a slide to the left. A cam rise on the slide then passes under a spring-pressed vertically sliding catch, which thus releases a slide to which the machine starting lever is pivoted. A spring completes the movement necessary for stopping the machine. —B.C.I.R.A.

Knitting Machine Needles. J. Hull and W. Spiers, XL Works, Leicester. E.P. 239,958.

A bipartite needle for use particularly in fine-gauge machines. The hooked member has a swell immediately behind the hook, and behind the swell is a groove. The guard or casting member, which is notched at the point to fit over the hook, is bevelled to work in the groove. The hook and guard members are independently operated by cams, a suitable arrangement being described, and they may be held in contact by means of a spring pressed cam pivoted on the top of the cam box. Where the straight edge of the guard makes contact with the stem of the hooked member, the straight edge of the guard is cut away at a point near the extremity to enable the guard to cant slightly when sliding on the swell and so enter and expand the loop. —B.C.I.R.A.

Loom Check Strap Guide. Pilling & Sons, Colne, and T. Richards, Nelson. E.P. 240,008.

The guides for the check strap of a loom are fitted with rollers mounted on one or both legs of the guide, or on separate pins, so as to engage the edges of the strap. —B.C.I.R.A.

Weft Stop Motion. J. Taylor, Milnrow, and F. Goodlad, Littleborough, Lancs. E.P.240,044.

In devices for putting the take-up motion out of action when a weft thread breaks, a spring steel lever is interposed between the weft-fork lever and the catch lever connected with the take-up motion, so that the weft-fork lever motion is reinforced at the catch lever. To hold the catch lever in its off position till the loom

is restarted, a spring catch is provided. Instead of the spring catch the steel lever may be extended beyond the catch lever, so that when the loom is stopped the starting handle becomes interposed between the weft-fork lever and the steel lever. In a modification the weft-fork lever operates the steel lever through the medium of the starting handle, which moves a short distance with the weft-fork lever and then towards the catch lever when the weft breaks. —B.C.I.R.A.

Loom Pile-wire Mechanism. Mohawk Carpet Mills, New York, U.S.A. E.P. 240,132.

The hopper for inserting and withdrawing the pile wires in the pile-fabric loom is caused to slide along a guide by means of a lever A to one end of which it is connected by an adjustable screw link, the lever A being pivoted at the end farthest from the link. A second lever B, situated on the right of A, pivoted at one end and connected at the other through an adjustable link to a point on the lever A, a short distance behind the hopper link, is slotted and is operated by a block on a pin adjustably secured in a radial slot in a crank-arm on the driving shaft, whereby the lever is caused to swing more quickly in one direction than the other. The link between levers A and B which, in the position of rest when the levers are nearly parallel, is inclined at an angle, then moves from the inclined position to a nearly horizontal position as the lever B moves to the left, and consequently the lever A, carrying the hopper along the guide, moves away from it, thus receiving an added impetus at the end of each stroke of the lever B. The hopper is thus given a high velocity at the end of its stroke in both directions.

—B.C.I.R.A.

Pile Fabric Loom Tube Frame Carrying-Chains. Platt Bros. & Co. Ltd., and F. W. Austin, Oldham, Lancs. E.P. 240,400.

The parts of the tube frame carrying-chains situated near the place where the tube frames are removed from the chains for insertion of tuft yarns in the fabric and are afterwards returned to the chains are held stationary from time to time whilst the remaining parts of the chains are driven continuously. To enable this to be done the chains are engaged by upper sprocket wheels and are passed around lower sprocket wheels on a shaft, which at times is driven intermittently and at other times is held stationary, by means of a star-wheel and a peg-wheel with a locking segment or ratchet mechanism. Details of the mechanism are given. —B.C.I.R.A.

Warp Knitted Fabric: Warp Machine. M. Sonntag, Grüna, Saxony. E.P. 240,664.

A double-ply warp fabric of which the yarns of one ply are not visible from the other face is produced on a machine with two needle bars and needles arranged directly opposite one another. A one-and-one warp fabric is made on one row from one set of yarns, whilst the other row makes chains of loops from other yarns. The runs of yarn between the needle loops cross each other inside the fabric in such a way as only to show up on the correct face, so that mixture of colours is avoided. Unknitted wefts may be laid in. In the machine the needle bars, which may be fitted with bearded or latch needles, are inclined at approximately right angles. One set of needles works with one or more sets of warp guides, whilst a second set is out of action. Similarly these needles work with certain guides, whilst the first set of needles is out of action. —B.C.I.R.A.

Shuttle Changing Mechanism. Riera y Cordoba, Barcelona, Spain. E.P. 240,783.

The shuttle box has a bottom which is lifted to direct one shuttle out of the box, and a front which is lifted to allow of the introduction of another shuttle, the operation being controlled by weft feeler mechanism. Details are given of the rod and lever mechanisms controlling the box bottom and front. —B.C.I.R.A.

Loom Shuttle. R. Codina and V. Martiñez, Barcelona, Spain. E.P.241,093.

In loom shuttles of the type in which the spindle is inserted in a hole in a member rigidly secured to the body of the shuttle and secured by a spring clutch device engaging a recess in the end of the spindle, the clutch lever is provided with a spring and mounted on a support, and a bell-crank lever secures the pirn or cop on the spindle by engaging the rim of it, the base of the spindle, by engaging an arm, preventing the release of the pirn from the spindle so long as the spindle is in the shuttle.

—B.C.I.R.A.

Loom Overpick Motion. W. Hörtsch, Oberfranken, and K. Werner, Nürnberg, Germany. E.P.241,124.

In overpick looms, both picker arms are driven by means of a single striker bar adjustably pivoted to a bell-crank lever operated by a tappet on the crank shaft, the bar engaging either an upper lever fast to the spindle of the picker arm or a lower lever, which is loose on the spindle but is connected by lever mechanism to the spindle of the picker arm. The bar is raised at the required times into position to engage the upper lever by a pin on an adjustable lifting member connected adjustably by a pin and slot arrangement to a bell-crank lever operated by a stud on a pinion driven from the crank shaft. The lifting member may have a guide bush.

—B.C.I.R.A.

Loom Shuttle. P. Comeau, New Bedford, Mass., U.S.A. E.P.241,145.

The threading recess of the shuttle communicates with the bobbin recess by a narrowed part. A guide wire anchored at one point and bent downwardly at a second point to pass through a side aperture, passes along the shuttle groove to be again anchored to the shuttle. The side aperture communicates by a narrow aperture with a thread eye. The thread is guided to the side aperture by the guide wire, is pulled through it, and is then led through the narrow aperture to the thread eye.
—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Weaving—

239,339. H. Walbank. Jacquard cards and card chains.

239,656. E. A. Mack. Hand-power loom.

239,756. W. Youngjohns and Cooke Bros. Ltd. Pile fabric loom.

240,249. Tannwalder Baumwollspinnfabrik. Double stroke dobby device.

240,672. E. Hollingworth. Double pile fabric.

240,704. J. Harper and W. Harris. Shuttle threading device.

241,008. J. T. Hardaker. Jacquard griffe operation device.

241,080. Sir W. N. Brown. Warp damping device.

241,112. British Northrop Loom Co. Weft replenishing device.

Knitting—

239,572. E. L. Cummings. Circular knitting machine: loop-pile fabrics.

Embroidering—

239,850. Maschinenfabrik Kappel, A.-G. Embroidery machine: link work device.

Subsequent Processes—

239,297. A. A. Whitley. Tentering clips.

4—CHEMICAL AND OTHER PROCESSES

(E)—Drying and Conditioning

Heat Economy Investigations on Cloth Drying. C. Marschik. *Leipsiger Monats.* 1925, **40**, 411-413.

The author gives a dissertation on relative humidity and dew-point relations for air. A graph of the relation between saturation quantity of water in air and temperature is given and its use exemplified. The importance of avoidance of waste due to heat conduction through the walls of the drying chamber is referred to and the desirability of effective control of drying conditions, viz., speed of air and of cloth through the machine, rate of heat supply, &c., is emphasised. Evaporation curves for various kinds of cloths obtained at different temperatures are given.
—L.I.R.A.

Heat Economy Investigations in Cloth Drying. C. Marschik. *Leipsiger Monats.*, 1925, **40**, 451-453.

The concluding article on cloth drying investigations. The following relations have been found to hold for artificial drying. The time taken for drying is—(1) Inversely proportional to the square of the temperature in degrees centigrade; (2) directly proportional to the weight per square yard of the material; (3) independent of the quantity of material (under standard conditions). Evaporation curves are shown for various materials dried at temperatures—50° C., 60° C., 70° C., 80° C., and 90° C. —L.I.R.A.

Improvement of Methods for Conditioning Textile Fibres. J. Obermiller. *Melliand's Textilberichte*, 1925, **6**, 765-769.

Following his investigation of methods of determining the moisture content of textile materials, the author has made experiments on the drying of fibres in currents of air of various relative humidities and at various temperatures. The residual moisture in materials dried at 105-110° C. in air of 75% relative humidity is about equal to that in material dried at 95-100° C. in air of 55% humidity (about 0·4% for cotton). From the results of his experiments the author recommends a temperature of 95-100° for conditioning vegetable fibres, a slow current of air of 50-55% relative humidity, referred to a room temperature of 15-25° C. being passed through the material. The combustion gases from the source of heat should be prevented from reaching the material under test. The temperature recommended is readily obtained by steam heating, and at this temperature there is no danger that the strength of the goods will be appreciably impaired. —L.I.R.A.

(G)—Bleaching

Bleaching. G. Ullmann. *Melliand's Textilberichte*, 1925, **6**, 508-510.

A lecture in which some modern bleaching problems are discussed. The author deals with certain imperfections in the boiler apparatus, the drying of bleached cloth in drying rooms as compared with machine drying, and the Mohr process of bleaching as compared with older methods. The author claims priority in regard to the Mohr process since in 1907 he worked out a similar continuous process.
—B.C.I.R.A.

Action of Bleach. H. Kauffmann. *Melliand's Textilberichte*, 1925, **6**, 591-592.

Discussion of the $KMnO_4$ method of estimating oxycellulose. From determinations the possible formula $C_{12}H_{20}O_{15}$ is suggested for oxycellulose. Kauffmann suggests that hypochlorites are not the active constituents of bleach solutions, but the free hypochlorous acid. This is produced by the hydrolysis of hypochlorites, even in alkaline solution.

$$OCl' + H_2O \rightleftharpoons HOCl + OH'.$$

In a bleach lye containing 0·4 grm. NaOH and 2 grams active chlorine, there is 0·1 mgm. HOCl. Two hypotheses are mentioned to account for the mode of action of the hypochlorous acid. —B.L.R.A.

Bleaching Powder: Heat of Formation. O. Nydegger, B. Neumann, and G. Müller. *Z. angew. Chem.*, 1925, **38**, 549-550.

Nydegger found for the heat of formation of bleaching powder the value 265 cal. per grm. of active chlorine, whereas Neumann and Müller obtained a value of 247·5 cal. These authors criticise Nydegger's apparatus and procedure and do not accept his value. —B.C.I.R.A.

Bleach Liquor: Preparation. E. Müller. *Z. Electrochem.*, 1925, **31**, 323-331.

A potentiometric method may conveniently be used to determine the point at which the equivalent quantity of chlorine has been added in the preparation of bleach liquors from chlorine and a solution of calcium hydroxide. Of a large number of electrodes investigated, the most satisfactory method is the use of an indicator electrode coupled with a special electrode under such conditions that at the equivalent point no current passes. In the apparatus described both electrodes consist of platinum plates, one of which dips into the bleach liquor whilst the other is enclosed in a porous clay cell filled with bleaching powder, slaked lime, and water. The electrodes are connected through a differential capillary electrometer and no current passes when the equivalent quantity of chlorine has been added. The method is not affected by the concentration of alkali used and concentrated bleaching solutions can be obtained in almost theoretical yield. —B.C.I.R.A.

Viscose Silk: Bleaching and Sulphur Dioxide Solubility. H. Matthes and P. Schütz. *Kunstseide*, 1925, **7**, 101-105.

A review of the patent literature dealing with the applications of sulphurous acid and the bisulphites in viscose manufacture. The importance of sulphurous acid for removing impurities from raw viscose, as a coagulating agent, and for removing the sulphuretted hydrogen formed in the spinning bath, led the authors to determine its solubility in solutions of sulphuric acid and of the various salts employed in the spinning bath and at the temperatures concerned. The experimental method is described and the results show that the solubility is such that considerable quantities of sulphur dioxide are absorbed even at high temperatures. A saturated solution affords sufficient sulphurous acid to oxidise the hydrogen sulphide, to coagulate the viscose, and to bleach the filaments. —B.C.I.R.A.

Methylene Blue Number as an Index of Bleaching Damage. E. Ristenpart and K. Petzold. *Leipziger Monats.*, 1925, **40**, 307-309.

The authors refer to the investigations of Birtwell, Clibbens, and Ridge, on the analysis of cotton oxycellulose, and describe related experiments they have themselves conducted. They conclude that the Methylene Blue number increases in accordance with the degree of tendering both when acid and alkaline hypochlorite solutions are used. There is also a similar correspondence between the copper number and the degree of tendering. —L.I.R.A.

Purification of Effluent from Bleach Works. See Section 7A.

(H)—Mercerising

Caustic Soda Lyes in Piece Mercerisation: The Recovery of, by the Matter System. KR. *Melliand's Textilberichte*, 1925, **6**, 665-666.

The apparatus described has several interesting features. The cloth passes from a mercerising machine into a steam chamber cut off from the air by a water-seal. In the bottom of the chamber a number of washing troughs are arranged in step-wise formation. The cloth passes alternately through these troughs and the steam-space above. The condensation of the steam on and in the cloth gradually dilutes and removes the caustic lye. The process of washing and steaming is repeated ten times within the chamber and ensures a very complete recovery of the lye. The exclusion of air prevents the formation of oxycellulose or the conversion of the caustic soda into carbonate. A lye of 12 to 15° Tw. is recovered. —L.I.R.A.

Apparatus for Controlling the Temperature and Strength of the Caustic Lye used in Mercerising. O. Funke. *Melliand's Textilberichte*, 1925, **6**, 667-668.

Besides indicating the temperature and strength of the caustic lye flowing into the impregnating trough of the mercerising machine, this installation (Otto Funke and Co., Elberfeld) provides for the automatic adjustment of the lye to the desired density. It consists of upper and lower storage tanks, a tank containing strong caustic lye, the automatic indicating and measuring apparatus, together with a pump and the necessary piping. —L.I.R.A.

Mercerised Cellulose: X-Ray Structure. K. Hess. *Z. Elektrochem.*, 1925, **31**, 316-319.

A controversial discussion of the author's own work and conclusions, and the opposing views of Herzog and of Katz and Mark. The author is of the opinion that mercerisation is due to the salt-forming ability of the amphoteric colloid and is not caused by a change in the chemical structure of the molecule. The original crystal lattice of the fibre is converted by salt formation into a kind of ion-lattice, the displacement of the $C_6H_{10}O_5$ groups caused by the inorganic component being irreversible. —B.C.I.R.A.

Artificial Silk - Cotton Mixtures: Mercerising. *Kunstseide*, 1925, **7**, 124-125.

A note on the possibilities of mercerising fabrics containing artificial silk and cotton, the difficulty being to obtain a process sufficiently stringent to mercerise the cotton and yet not to damage the artificial silk. A mixture of sodium hydroxide and alcohol in the proportion 94·7 to 5·3 has been suggested, the alcohol serving to protect the artificial silk, but the process is too costly for commercial use. —B.C.I.R.A.

Mercerisation. *Kunstseide*, 1925, **7**, 206-208.

A review of the Heberlein patents. Samples of new cotton fabrics having a linen-like effect, a transparent effect, and an opalescent effect, are supplied. —B.C.I.R.A.

Mercerising and Philanising. E. O. Rasser. *Kunstseide*, 1925, **7**, 78-80.

An historical sketch of the mercerising and philanising processes. The latter is confined to treating the cotton with acids to obtain the mercerised effects, with or without tension, and the author outlines the conditions when working with nitric acid. The process is at present worked only at the Hoechst works, where there is plant for synthetic nitric acid manufacture, but the author suggests that there is a commercial future for the philanised fabric. —B.C.I.R.A.

(I)—Dyeing

Metallic Salt Dyes: Application. P. Montavon. *Rev. Gén. Mat. Col.*, 1925, **29**, 230-231.

Some notes on the production of Bistre or Manganese Brown, and of Prussian Blue and Prussian Green colours on fabrics. —B.C.I.R.A.

Nitrosamines: Application. P. Wilhelm and N. Wosnessenski. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 320-321; Pli cacheté No. 2055.

The sodium salt of ortho-nitrotoluene-sulphonic acid, manufactured by Kalle and Co. under the name Reserve Salt W, may be used as a resist in vat dyeing and enables nitrosamines to be employed instead of diazo colours for the production of patterned effects. —B.C.I.R.A.

Fastness of Dyes. B. Sala. *L'Avenir Textile*, 1925, **7**, No. 11, pp. 559-564.

A description of methods available for the estimation of the fastness of dyes on textiles to the action of light, water, rubbing, soap, sponging, acids, alkalis, boiling, sulphur, chlorine, dust, dirt, and perspiration. —L.I.R.A.

Dye Bath: Colloid Chemistry. —. Nowak. *Melliand's Textilberichte*, 1925, **6**, 503-506.

A general discussion, from a colloid-chemical point of view, of the changes taking place in dye baths during the process of dyeing. The baths are regarded as disperse systems, and the electric charge and degree of hydration of the particles govern the degree of dispersion of the particles of the dyestuff solution. The effect of concentration of the dyebath, the addition of salts, temperature, and the addition of protective colloids is discussed. —B.C.I.R.A.

Vat Dyestuffs on Cotton; The Fixation of——. K. Brass. *Melliand's Textilberichte*, 1925, **6**, 673-674.

The author describes experiments which show that carbon dioxide plays a part in the formation of cellulose-dye complex when the fibre impregnated with the dye vat is exposed to air. He develops the theory that the free vat-acid is liberated by the carbon dioxide and immediately combines with the cellulose, this being followed by oxidation to the dye-cellulose complex. —L.I.R.A.

Dyes: Dispersion and Penetration. —. Haller. *Melliand's Textilberichte*, 1925, **6**, 669-673.

A fuller account of a lecture already reported. Some of the photomicrographs shown are reproduced. —B.C.I.R.A.

Dyeing with Indanthrene Blue GCD. G. Durst and H. Roth. *Melliand's Textilberichte*, 1925, **6**, 837-839.

The authors describe small-scale experiments with Indanthrene Blue vats in which graphs showing the relation between time of dyeing and removal of hydrosulphite and caustic soda from the bath were obtained. The effect of temperature was also investigated. —L.I.R.A.

Vat Dyes: Application. K. Brass. *Z. angew. Chem.*, 1925, **38**, 810, 853-857.

Further accounts of experimental results and conclusions previously noted. —B.C.I.R.A.

Artificial Silk: Dyeing. G. Rudolph. *Kunstseide*, 1925, **7**, 73-74.

The author gives practical directions for obtaining good dyeing results with artificial

silk, and thus avoiding the streaky effects which he ascribes to faulty dyeing rather than to defects in the yarn. —B.C.I.R.A.

Artificial Silk: Dyeing. G. Rudolph. *Kunstseide*, 1925, 7, 7-8.

In connection with the streaky appearance of some artificial silk fabrics caused by uneven dyeing, the author describes laboratory methods of dyeing artificial silks with substantive and basic dyes in order to judge of their dyeing properties and behaviour in the dye house.

—B.C.I.R.A.

Cellulose Acetate Silk: Dyeing. J. Besançon. *Kunstseide*, 1925, 7, 120-121.

Cellulose acetate silk can be conveniently dyed with basic dyes if it is subjected to a preliminary treatment with a Kuhlmann product, "Acetonal N." The silk before dyeing is immersed in an Acetonal N bath at 30-40° C. for 20 minutes; after centrifuging and washing, it may be dyed with any of the common basic dyes without suffering loss of lustre or other desirable quality. —B.C.I.R.A.

Neolan Dyestuffs: Application and Effect on Spinning Property. Ruggli. *Melliand's Textilberichte*, 1925, **6**, 674.

A lecture on the chemical and dyeing properties of the above dyestuffs is reported. Neolan dyestuffs are chromium compounds which are easily soluble in hot water and upon which metals have no effect. They are applied similarly to acid dyestuffs in a sulphuric acid bath, except that 4-8% more acid is required to give the desired clear and fast colours. The dyebath is heated to 60-90° C., and one-fifth of the acid and then the dyestuff solution are added. The material is entered and slowly brought to the boil, when the remaining four-fifths of the acid are added gradually and boiled for another half-hour. Duration of the process is only 1½ hours. The affinity of the dyestuffs for wool is good and the bath is almost completely exhausted. A possible harmful effect of the high acid concentration on the quality of the wool has been suggested, but the lecturer states that both fibre and dyestuff at once combine with such considerable quantities of the acid as to prevent high concentration on the fibres. Results of experiments to show the effect of the process on the spinning properties of wool are reported and compared with differently dyed materials. At eight hours' run and 50 spindles, white wool gave 92 fibre breakages, Neolan Green 344, acid dye 355, and after-chromed dye 366-479. Spinning waste from white wool 0·9%, acid dye 2·38%, Neolan dyestuff 2·7%, and after-chromed dyestuff 3·26-3·7%. Neolan dyestuffs are especially suitable for tops and loose wool, give clear colours, and are easily dyed to shades. They also give good results in piece-dyeing, *e.g.* carbonised pieces can be entered at once into the boiling bath. Even faulty carbonised pieces give good results. Neolan dyestuffs are not very fast to potting, but their resistances to light, decatising, water, wear, dust, sulphur, alkali, and milling are very good. B.R.A.W. & W.I.

Thread; Dyeing, Dressing, and Polishing of Sewing——. A. Herrmann. *Leipziger Monats.*, 1925, **40**, 410.

Gives recipes for dressing and polishing yarns and threads for various purposes.

—L.I.R.A.

Indigo: Oxidation. L. Eymer. *Rev. Gén. Mat. Col.*, 1925, **29**, 225-226.

The explanation given by Prudhomme of the accelerating action of acids on the oxidation of indigo by chromic acid is inadequate. This explanation was based on the formation of unstable compounds of the chromic acid with the added acid, and does not explain why oxalic acid is more efficient than sulphuric acid. The added acids differ in their action according as they are oxidising, reducing, or, in this respect, neutral acids. In the absence of added acids, a chromium chromate is formed and all acids capable of preventing the formation of this substance by dissolving chromium oxide as it is formed are effective in accelerating the reaction. Oxalic acid has this effect, but, in addition, it acts through its reducing properties, bringing about, as Prudhomme himself stated, the liberation of oxygen in the form of ozone. That ozone plays an important part in the phenomenon is shown by the fact that when the liberation of ozone is prevented by the addition of hydrogen peroxide the indigo is not decolourised. The rapid discharge of indigo by chromic acid in the presence of oxalic acid is therefore due to the fact that oxalic acid is the only acid which reduces chromium oxide in the cold, with liberation of ozone. —B.C.I.R.A.

Analysis of Water for Dyeing. See Section 6.

(J)—Printing

Alizarin Rose and Red: Application. A. Scheurer. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 473-474. Pli cacheté No. 1839.

Conversion of rose and red shades to violet tones in the printing of Alizarin Violet in the presence of ferrous acetate is prevented by adding a basic aluminium choride to the solution of aluminium acetate used as mordant. Contamination of the rose shades by iron is avoided.

—B.C.I.R.A.

Metallic Powder Printing Pastes: Application. A. Scheurer. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 469-472. Plis cachetés, No. 1788, 2127, 2134, and 2135.

A thickening suitable for use in the application of metallic powders in printing is prepared by boiling gelatin with water under

pressure. A brownish liquid of the consistency of a thick gum is obtained. The metallic powder is suspended in the thickening. The printed fabric is exposed to formaldehyde vapour to render the design fast to water and soap.

—B.C.I.R.A.

Purification of Effluent from Finishing Works. See Section 7A.

(K)—Finishing

Finishing Fine Nap Cloths and Treatment of Crimps. Tennius. *Melliand's Textilberichte*, 1925, **6**, 422.

A detailed description of the complete process. The cloth is scoured, dried, milled to 15% of the length, shrinking the latter a little sooner than the width to avoid crimps, washed in warm and rinsed in cold water. Cloths dyed in the wool, and those which are to be dyed black, are carbonised at this stage and not before milling, de-acidified, and hydro-extracted. If the cloth is smooth it is just stretched and dried, cut 2-3 times, run in lukewarm water for ½ hour, and raised. If, however, the cloth is crimped it is dried under high tension, cut until smooth, hot-pressed for 2 minutes, allowed to cool on the roller. It is then wetted for preliminary raising ten times from opposite ends, followed by raising on the double carder ten times on one or both sides, and finally on the ordinary carder in water. The material is then hydro-extracted, dried, cut twice, and if necessary once more raised. This after-treatment is, however, not recommended if the material consists of noils. The cloth is again cut, pressed, decatised, wetted, raised wet, and left overnight. Subsequently it is dried, steamed, cut, steam-brushed, pressed twice, decatised, and again steam-brushed. Pressing without pressure on the right side, steaming, and cold pressing then complete the process.

—B.R.A.W. & W.I.

Dressing and Polishing Sewing Thread. See Section 41.

Patents

Method of Producing Semi-permanent Markings on Silk Fabrics. O. Osborne. U.S.P.1,529,500 (from *Text. Colorist*, 1925, **47**, No. 558, p. 394).

The fabric is pressed by a heated bed on to the moistened face of a heated die bearing the pattern. —F.G.P.

Cellulose: Swelling. Gebr. Himmelsbach A.-G. F.P.585,451 (from *Chem. Zentr.*, 1925, **i**, 2518).

The swelling and absorbing powers of wood or cellulose for dyes and preservatives are increased by a pre-treatment with steam containing small quantities of cresols or their homologues. Wood is treated at a temperature below 100° with steam containing cresols as catalysts for 6-18 hours, depending on the kind of wood and then impregnated in the ordinary way. The addition of cresols in the steaming process shortens the time of steaming by about one-third, and the swelling process may be carried out at a temperature about two-thirds below that required when using steam alone. —B.C.I.R.A.

Hank Dyeing Machine. P. Bach, La Valle, Belluno, Italy. E.P.239,369.

The patent relates to apparatus for dyeing skeins or hanks of the kind in which the carriers have journal-like side projections resting on the toothed edges of the vat, and in which means are provided, adapted to travel along the vat for automatically withdrawing and rotating the carriers through 360° before replacing them in the vat. The travelling machine, which moves along rails, is provided with rotating discs having guiding fingers adapted to co-operate with the side projections to lift the carriers from the vat, the machine also carrying adjustable and preferably elliptical abutments or stops adapted to co-operate with extensions of the cheeks of the carriers to rotate the carriers through 360°.

—B.C.I.R.A.

Chromium Plated Finishing Machine Parts. E. Schmitt, Chemnitz, Germany. E.P. 239,413.

Chain links, tentering clips, pin blocks, and other parts of fabric-finishing machines subject to wear or to the action of moisture, lyes, &c., are coated entirely or partly with chromium. The parts may be constructed of an inferior metal, such as iron.

—B.C.I.R.A.

Cellulose Acetate: Dyeing. British Celanese, Ltd., London, and G. H. Ellis, Spondon, Derby. E.P.239,470.

Products made of or containing cellulose acetate are dyed, printed, or stencilled by means of unsulphonated diarylamines (other than 2.4-dinitrodiarylamines) containing or not containing hydroxy, chloro, amino, or other substituents, applied in aqueous solutions or suspensions, or by any method other than that claimed in Specification 237,943. The dyestuffs may be finely ground and suspended in acid or alkaline aqueous baths or pastes, to which may be added protective colloids, such as glue, starch, gums, &c., or they may be dissolved in an organic solvent and poured into the dyebath, which may contain a protective colloid. Some examples are quoted.

—B.C.I.R.A.

Cloth Expander. W. O. Harrap and Harrap, Wilkinson, Ltd., Salford, Lancs. E.P.239,740.

In a cloth expander, rotatable unit bobbins are mounted on a curved bar or support,

and are formed with cylindrical end compartments into which a ball or roller bearing is introduced, the balls being carried in a thin metal cage to allow them to engage the bobbin and bar, and means are provided for securing the bearing in place. —B.C.I.R.A.

Viscose Silk: Dyeing. Burgess, Ledward and Co., F. Scholefield, and N. Denner, Manchester. E.P.239,981.

Viscose silk in the form of yarn or fabric is desulphurised and lustred during the dyeing, mordanting, or cleaning process, so that its greater strength when in the sulphur state is retained as long as possible. Directions for dyeing yarn in the sulphur state with specified direct colours, vat colours, sulphur colours, basic colours, and developed colours are given. —B.C.I.R.A.

Cellulose Acetate: Dyeing. British Dyestuffs Corporation, Ltd., L. G. Lawrie, and H. Blackshaw, Manchester. E.P.240,293.

Cellulose acetate materials are dyed with mordant dyestuffs by applying to the silk the metal mordants in the form of their thiocyanates or salts of the aromatic carboxylic or hydroxy-carboxylic acids, and then dyeing. Suitable salts are aluminium, chromium, and ferrous thiocyanates, aluminium salicylate, iron salicylate, or benzoate and chromium benzoate, salicylate, or phthalate. In examples, the silk is treated with aluminium thiocyanate and then with sodium carbonate, and dyed with Alizarine IP and chalk, with chromium thiocyanate and then sodium carbonate and dyed with Anthracene Blue BDG, with iron thiocyanate and oxalic acid, and dyed with hematin crystals, and with chromium salicylate neutralised with sodium carbonate and dyed with Chromazol Violet.

—B.C.I.R.A.

Decorative Openwork Fabrics: Finishing. R. Stevenson and F. W. Wakefield, Dungannon, Ireland. E.P.240,378.

Fabrics composed of animal and vegetable threads are treated with an alkaline solution of such strength and temperature that the animal threads are removed and the vegetable threads are simultaneously mercerised, thereby producing a decorative openwork effect as determined by the manner in which the vegetable threads are disposed in the fabric. The alkaline liquid may be caustic potash or caustic soda of 20-40° Tw., and the treatment may be carried out at 180° F. After the fabric has been passed a number of times through the alkali, it is washed, soured, re-washed, and dried. —B.C.I.R.A.

Cellulose Acetate Silk: Dyeing. Badische Anilin u. Soda Fabrik, Ludwigshafen-on-Rhine, Germany. E.P.240,514.

In the dyeing or printing of cellulose esters, and particularly of cellulose acetate silk, the ester is treated previously or simultaneously with a solution of an acid ester of a mineral oxygen acid, such as sulphuric, phosphoric, or boric acid, or with a solution of a salt, such as acid ester. In examples, cellulose acetate silk is dyed by treatment first in a warm bath of potassium ethyl sulphate, and then in a bath of Diamond Green B; by treatment first with sodium dicresyl phosphate and subsequent dyeing with Methyl Violet 2B, with or without waste sulphite liquor, or Azoflavine RS, or with a hydrosulphite vat of Indanthrene Blue GCD containing, if required, a protective colloid; and by treatment in a bath containing both sodium dicresyl phosphate and the dyestuff Auramine II. A further example shows the printing of acetate silk with a paste comprising Euchrysine 3R, dicresyl phosphate, acetine, and gum.

—B.C.I.R.A.

Drying Machine. British-American Laundry Machinery Co., Cincinnati. Ohio, U.S.A. E.P.240,621.

Apparatus for drying materials comprises a rotary perforated drum mounted with a casing which can be inclined, the material being subjected to the circulation of a current of air which is drawn by a fan through an opening into a duct containing trays of calcium chloride, and thence through an adjustable opening, and perforations in the drum to an outlet duct. When dried, the batch of material is automatically ejected from the drum by means controlled by a psychrometer which, when the humidity of the circulating air reaches a predetermined point, closes an electric circuit, which thus actuates a motor which tilts the casing on its axis and opens the discharge door of the drum. The drum and fan are driven by independent motors and the feed doors and the discharge door are held closed by electro magnets.—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Finishing—

239,360. E. R., and S. R. Trotman. Wool treatment to render unshrinkable.

240,023. C. Welch and J. Thompson. Thread drawing machine.

240,934. G. Dod. Stenter chain lubrication device.

240,041. J. W. Maud. Ironing machine with roller and stationary iron.

Bleaching—

239,554. S. A. Ogden. Bleaching process for animal fibres.

240,482 and 240,499. E. C. Duhamel. Washing and bleaching process for wool, silk, &c.

Dyeing—

240,236. Fuld and Hatch Knitting Co. Fabric dyeing machine, c.f. E.P.211,437.

Washing—

240,477. E. C. Duhamel. Wool washing process.

5—LAUNDERING AND DRY CLEANING

Foaming Power of Soaps. R. Jungkunz. *Seifensieder Zeitung*, 1925, **52**, 279.

This article contains references to the work of Richardson and Jaffé, Stiepel, Steffan, Weston and Kind, and Sschacke, on this subject. A table of results obtained by Richardson and Jaffé for 13 different commercial soaps is given. —B.L.R.A.

Foaming Power of Soaps. R. Junkunz. *Seifensieder Zeitung*, 1925, **52**, 255, 279, 301, 324, and 345.

The author worked with "pure" neutral soaps of different fats. The method of preparation and experiment is described in detail. Figures are given for 12 different soaps, and show that in general—(*a*) Soaps from saturated fatty acids have higher foaming numbers than those from unsaturated. (*b*) Rosin soaps have low foaming numbers. (*c*) K soaps usually have lower foaming numbers than Na soaps; K soaps from coconut and castor oil have, however, higher foaming numbers than the corresponding Na soaps. K and Na rosin soaps are the same. In hard water, coconut and, to a lesser degree, castor oil soaps have the highest foaming powers. In the last article of the series there is a discussion concerning the connection between foaming numbers and detergent action, in which no definite conclusions are reached.

—B.L.R.A.

Myrabole Oil. E. Wernicke. *Seifensieder Zeitung*, 1925, **52**, 304.

The physical properties and chemical constants of myrabole oil are given. It contains a maximum of 2% unsaponifiable matter, and consists chiefly of palmitic, stearic, and oleic acids. Soaps made from it vary from pure white to a pale yellow in colour, and lather well. —B.L.R.A.

Soap Solutions: Viscosity. N. A. Jajnik and K. S. Malik. *Kolloid-Z.*, 1925, **36**, 322-327.

The viscosities of solutions of pure sodium palmitate and stearate of varied concentrations have been measured at 60°, 70°, and 80° in a constant pressure viscosimeter of the type used by Scarpa and by Farrow. The viscosity increases rapidly with concentration. The viscosity of sodium palmitate solutions is lower than that of sodium stearate, but the differences become very small for solutions more dilute than N/20, especially at 60°. —B.C.I.R.A.

6—ANALYSIS, TESTING, GRADING AND DEFECTS

Folded Yarns: Calculations. *Text. Rec.*, 1925, **43**, No. 508, 55-56.

It is shown how twist equivalents may be calculated for yarns in which the single yarns are (1) of the same material and count, (2) of the same material but different in count, (3) different in both material and count. An alternative graphical method is described. —B.C.I.R.A.

Fibres: Grading by Capillarity. H. S. Busby. *Text. World*, 1925, **68**, 369-373.

A method is described for the classification of fibres according to their dye absorbing power. Representative samples are made from classified fibres, and samples from actual lots compared with these representative samples. The fibres are classified on the basis of the height to which a dye solution will rise up the fibre in a given time. The representative sample and the sample from the actual lot are compared after dyeing by the Dubosc colorimeter.

—B.C.I.R.A.

Instrument for Fabric Analysis. *Amer. Silk Jl.*, 1925, **44**, No. 6, p. 65.

This is a binocular microscope on a movable carriage over an electrically lit ground glass screen with micrometer action moving over the specimen. Eye strain is avoided; the warp and shoot may be read directly from a scale on the carriage; the hands are left free for dissecting. —F.G.P.

Wheat Flour Suspensions: Effect of Hydrogen Peroxide. R. K. Durham. *Cereal Chem.*, 1925, **2**, 297-305.

Hydrogen peroxide produces increased hydration capacity of flour or wheat meal and water suspensions, as determined by viscosity with a MacMichael viscosimeter. Different types of wheat vary greatly in their behaviour to hydrogen peroxide. Generally, there appears to be a relation between the hardness of wheat and its increase in viscosity with hydrogen peroxide. Middlings flour shows greater increase in viscosity than do lower grades. The substance affected by hydrogen peroxide is soluble in water. Inferior milling produces flour which shows low increase in viscosity with hydrogen peroxide.

—B.C.I.R.A.

Amylase: Effect of Heat. D. H. Cook. *J. Biol. Chem.*, 1925, **65**, 135-146.

The rates of starch hydrolysis by pancreatic and malt amylases, used in the form of commercial pancreatin and malt have been determined under special conditions for the range 20-70° C. At temperatures below the point where destruction of the enzyme plays an important part the rate of hydrolysis is about doubled for every 10° rise in temperature. Malt amylase is much more stable than pancreatic amylase in water-salt solutions; the latter was destroyed in 15 mins. heating at 50°, whilst malt amylase was slightly active after 30 mins. at 60°. Pancreatic amylase is apparently inactivated about 30 times as fast at 50° as is malt amylase. The results obtained support the view that the heat

destruction of the enzyme may be a process of the nature of the coagulation of a protein, probably accompanied by partial hydrolysis. —B.C.I.R.A.

The Corrosion of Certain Metals by Carbon Tetrachloride. F. H. Rhodes and J. T. Carty. *J. Ind. Eng. Chem.*, 1925, **17**, 909-911.

Of the various metals tested, nickel is the most resistant to cold carbon tetrachloride, either wet or dry, and to the dry vapour of carbon tetrachloride. Tin is the most resistant to the action of the wet vapour. Some interesting phenomena in connection with the corrosion of aluminium and brass are observed. —L.I.R.A.

Artificial Silks: Identification. E. O. Rasser. *Kunstseide*, 1925, **7**, 117-120.

A review of the physical and chemical methods of identifying the various artificial silk fibres and of distinguishing them from natural silk. Relative measurements of diameter, resistance to tearing, water content, and hygroscopicity are given. —B.C.I.R.A.

Cellulose: X-Ray Structure. (1) W. Basche and E. Pohland. (2) O. Hassel. (3) K. Weissenberg. *Z. Elektrochem.*, 1925, **31**, 523-530.

Three papers read before the Deutsche Bunsen-Gesellschaft on crystal structure. Recent work points to the conception of matter as discontinuous, and crystals are regarded as being made up of a number of isolated groups of particles termed by the author "islands." Islands may be of four kinds—micro-islands, island chains, island-networks (two-dimensional), and island-spatial lattices. Only the micro-island contains a finite number of atoms, and is of finite volume. The crystal contains per substance element at least as many structurally similar micro-islands as is indicated by the lowest number of structurally similar points in the substance element. In any lattice a given group of atoms is termed a dynad when the atoms of the group are mutually bound together by forces of cohesion greater than those acting between the atoms in the group and those outside. Thus each dynad of a crystal is an island in the crystal. The dynad conception is not confined to crystals; for instance, the molecule of a gas or a grain of sand in a heap is a dynad. Simple polymerised bodies, such as metaldehyde, have been studied and the results are in agreement with physical-chemical theory. It was pointed out in the discussion that cellulose does not give a sufficiently clear Röntgen spectrograph to test the theory but that such evidence as there is indicates that the structure of cellulose agrees with the dynad conception, except that the actual size of the molecule is not determined. —B.C.I.R.A.

Lignin: Constitution. W. Küster and E. Schnitzler. *Z. Physiol. Chem.*, 1925, **149**, 150-172.

Lignin, prepared in the special way described by treating pine wood meal with a phenol, was fused with β-naphthol at a temperature of 180-200°, and three products isolated from the melt. It is apparent that the β-naphthol takes part in the reaction. The first two products correspond to 90% of the original lignin. They are amorphous, of high molecular weight, contain methoxyl, and are chemically very active. The third product is termed "merolignin." The first two products are related to one another, since on further fusion with β-naphthol the first is partly converted into the second, but no merolignin is obtained. Thus, lignin must consist of two independent complexes which on fusion with β-naphthol are split up, and the reaction affords proof that merolignin is a constituent of lignin. The empirical formulæ and properties of the compounds are fully described, and the relationship of lignin to the resin acids on the one hand and to cellulose on the other indicated. It is suggested that in wood, cellulose and lignin are in chemical combination, and that the linkage in destroyed by the β-naphthol fusion. The author's conception of lignin as a uniform identity built up from two different constituents, one present in much higher proportion than the other, is the novel feature of the research. —B.C.I.R.A.

Fats and Oils: Analysis. German Commission for the Standardisation of Analytical Methods in the Fat Industry. *Z. angew. Chem.*, 1925, **38**, 958-965.

Tentative specifications are put forward in connection with the establishment of standard methods for the examination of fats and oils. —B.C.I.R.A.

Sodium Hypochlorite Solution: Properties. R. Dietzel and F. Schlemmer. *Z. Anorg. Chem.*, 1925, **145**, 381-393.

The reaction $2NaOH + Cl = NaOCl + NaCl + H_2O$ has been investigated by titrimetric and absorption spectra methods. If the reaction proceeds as above, a solution containing 1 mol. of sodium hypochlorite should be obtained per mol. of chlorine adsorbed. Actually, the largest quantity of hypochlorite found by titration with thiosulphate, silver nitrate, or arsenious acid was about 0·5 mol. Since the total quantity of chlorine is not recovered, it is assumed that part of the chlorine introduced forms stable compounds in which the chlorine cannot be determined by the usual titration methods. Dilute hypochlorite solutions are fairly stable, if prepared and stored under suitable conditions. A slight excess of free chlorine or hypochlorous acid causes a rapid change, according to the equation $ClO' + 2HClO = ClO_3' + 2H' + 2Cl'$. —B.C.I.R.A.

Cellulose: Action of Ammonia. G. Bernardy. *Z. angew. Chem.*, 1925, **38**, 838.

The action of 22% ammonia is similar to that of other alaklis but is less intense. Alkali-soluble cellulose is dissolved out and at higher temperatures and pressures, humin substances are formed and, finally, the cellulose is disrupted, forming a brown powder in which the fibrous structure is still preserved. The action of 22% ammonia on cellulose previously swollen with sodium hydroxide is essentially the same as its action on pure cellulose. The scouring action of 22% ammonia on raw cotton is much less efficient than that of 1% sodium hydroxide. Whilst only ½-¼ of the amount of fatty and waxy matter removed by 1% sodium hydroxide at 100° is removed by ammonia at this temperature, the nitrogen content is reduced to 0·05% as compared with 0·02-0·03% in the ordinary dilute soda process. By the action of 22% ammonia at 100°, the copper, cellulose, and hydrolysis numbers of cotton from which fatty matter has been removed are not altered. When cellulose is treated with gaseous ammonia at -33 to -35° swelling takes place. The corrected copper number of the swollen cellulose is 0·166 and the corrected hydrolysis number is 4·464. —B.C.I.R.A.

Faults in Textile Goods and their Causes. Jovanovits. *Melliand's Textilberichte*, 1925, **6**, 831.

The author summarises in tabular form faults commonly occurring in cotton goods through imperfect bleaching, dyeing, &c. The causes of these faults are similarly summarised. A useful bibliography is given. —L.I.R.A.

Cotton: Copper Number and Tendering. H. Korte. *Melliand's Textilberichte*, 1925, **6**, 663-664.

Attention is drawn to Clibbens and Geake's method of determining copper number, the simplicity of which places it within the power of even small bleacheries. A comparison of the estimation of oxycellulose by this method, Schwalbe's method, and the permanganate method of Kauffmann, has been made, using a 2/40's Egyptian cotton yarn subjected to different scouring and bleaching treatments, in which the concentrations of sodium peroxide and of chlorine employed were higher than those in use in bleaching practice. Breaking load determinations at 65% relative humidity were also made. The tabulated results indicate that the condition of a treated yarn can only be judged by the estimation of oxycellulose in conjunction with breaking load. The estimation of oxycellulose alone may lead to inaccurate deductions. As different methods of determining copper number give different results, the method adopted must always be stipulated. —B.C.I.R.A.

Allwörden's Reaction. Spöttel. *Melliand's Textilberichte*, 1925, **6**, 359, 439, and 605.

A review of histological and chemical investigations of the above reaction, which all give the same negative result regarding the presence of elasticum in wool. Only medullated hairs show the characteristic "blisters" on addition of chlorine water. Allwörden's reaction, it is stated, depends on the structure of the epidermal cells and the way in which they are attached to the hair. The action of acid or alkali on these "blisters" is the result of their respective shrinking or swelling effects on the epidermal cells.

[The presence of "elasticum" as an individual constituent of wool cannot be considered proved or contradicted, but Spöttel is certainly incorrect in confining the reaction to medullated fibres. Fine merino fibres exhibit the reaction very definitely.—(Abstractor.)]

—B.R.A.W. & W.I.

Extension Tester and Tests: Elasticity Moduli of Various Fibres. Schmid. *Melliand's Textilberichte*, 1925, **6**, p. 436.

Polanyi's extension tester is described which consists of a steel spring carrying the upper part, and a micrometer screw which is connected to the lower part of the apparatus. The lowering of the micrometer screw causes a tension of the thread between the two parts, which is transmitted to the steel spring. The deflection of the latter is recorded by a mirror at each end, a telescope, and a scale. The fibre itself is surrounded by a glass cylinder through which air of a definite moisture is continuously drawn. Interesting extension curves for wool, camel hair, ramie, cotton, tussah silk, and viscose are given, and also others showing the effect of moisture contents of the fibres on their tensile strength. It was found that an increasing moisture content caused a systematic decrease in the tensile strength of wool and viscose, but an increase in their elongation at break. In the case of tussah silk, this effect was reversed, and with cotton even more so. The paper further gives the elasticity moduli, elastic limits, elasticity, and total tensile strengths of wool and tussah silk, also obtained on the above tester. These are tabulated below—

	Elasticity Modulus	Elastic Limit	Elasticity	Total tensile strength on 1 gram
	kg./mm.2	kg./mm.2		cm. kg.
Wool ...	470	2·7	26·5%	112
Tussah silk ...	715	5	31·2%	186

B.R.A.W. & W.I.

Wood Pulp: Testing. K. Rieth. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1925, **23**, 525-529.

A reliable method for determining the strength of wood pulp is described, based

on the fact that the maximum breaking length is attained when the pulp has been beaten to a parchmentised condition, and that this condition can be recognised by application of the "blister" test. The sheets of pulp are beaten in a miniature beater, and test sheets are made at intervals on a Büchner funnel provided with a fine wire sieve. The sheets are dried on a hot copper surface and are submitted to the "blister" test. When a strongly positive test is obtained, a latitude of 15 minutes may still be allowed without danger of over-heating. The sheets for strength tests are then made under standard conditions in a special funnel fitted with a perforated copper plate and 70-mesh sieve. The breaking length is subsequently determined and corrected for humidity. In judging the quality of wood pulp by this method, its chlorine consumption value must be taken into account. The lower the chlorine value in conjunction with a higher tensile strength the higher the value of the pulp.

—B.C.I.R.A.

Cellulose: Swelling, and Adsorption. C. G. Schwalbe and G. A. Feldtmann. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1925, **23**, 589-595.

A simple practical method of determining the amount of water taken up by cellulose in the form of paper is described. The results after soaking paper strips in (1) water, (2) 1% acetic acid solution for four hours, are tabulated and in both cases the water absorption is roughly the same. The time factor is important. Fairly wide differences in water absorption are shown as between the different celluloses tested, the values for bleached celluloses being well below those for unbleached. The authors studied swelling phenomena in cellulose, using the common mordants, salts of chromium and aluminium being known to give useful results. A practical method, based on Gladstone's direct method, for determining the degree of swelling by measuring the adsorption of ferric oxide, is described. A preliminary experiment is necessary to determine the amount of ferric oxide (Fe_2O_3) taken up by celluloses mercerised under different conditions of alkali concentration. The amount of Fe_2O_3 taken up by 100 grams of ash- and water-free fibre is designated the iron-oxide number. The results for a number of mercerised cottons and wood celluloses show in general a proportionality between the water absorption and the iron oxide number, but in a discussion of the results it is pointed out that the adsorptive power of cellulose for salts is greatly influenced by various factors, notably the previous history of the fibres, the surface structure, and the content of incrusting substances, &c.

—B.C.I.R.A.

Acids on Viscose Silk. P. Krais and K. Biltz. *Leipsiger Monats.*, 1925, **40**, 354.

If the acid is not completely rinsed out of the fabric, and the fabric is then heated at 90° C. for one hour, the following concentrations of acid should not be exceeded—Lactic acid 1%, acetic and tartaric acids 0·3%, oxalic acid 0·1%, and sulphuric acid 0·05%. Tables of strengths are given.

—B.L.R.A.

Hydrolysis of Celanese. R. Haller and A. Ruperti. *Leipsiger Monats.*, 1925, **40**, 353.

The rate of saponification of Celanese with NaOH at different temperatures, and with different concentrations of sodium acetate, sodium chloride, or sodium nitrate present, is shown in a series of curves.

—B.L.R.A.

Fastness Properties of Dyes; Suggestions for Simplified Methods of Testing the——. W. Heinisch. *Leipsiger Monats.*, 1925, **40**, 313.

In order to avoid the necessity for a multiplicity of standard dyeings, the author suggests the following procedure. As a standard a very light dyeing (1/10%) of a dye of poor light-fastness is chosen. The test object is illuminated, together with the standard dyeing, and if the former loses its colour in the same time as the standard, it is classed as a dyeing of poor fastness. If the test-object resists the action of light longer than the standard, the latter is renewed and the illumination continued. Thus a measure of the light fastness of a test-piece is given by the number of standard dyeings it will outlast. In testing very fast dyeings, a standard of medium fastness may be chosen.

—L.I.R.A.

Cellulose: Dispersion. P. P. von Weimarn. *Kolloid-Z.*, 1925, **36**, 338-341.

Some experiments on the dispersion of different kinds of cellulose by mechanical means and by the action of aqueous salt solutions are described. Dispersion in concentrated salt solutions is accompanied by hydrolysis with the production of substances in true solution. The type of cellulose used determines the rates of dispersion and hydrolysis. Preliminary mechanical or chemical treatment accelerates the dispersion of resistant types of cellulose.

—B.C.I.R.A.

Caustic Alkalis: Adsorption; Part II. S. Liepatoff. *Kolloid Z.*, 1925, **37**, 112-116.

Describes experiments on the rate of adsorption from aqueous alcoholic solutions of caustic alkalis by cellulose. The author derives a formula for the adsorption velocity and concludes that the process of adsorption is of a chemical nature. Owing to the reduction of hydrolysis, the adsorption of alkalis from an alcoholic solution is an irreversible process.

—L.I.R.A.

Turgoids. E. Justin-Muller. *Kolloid Z.*, 1925, **37**, 239-244.

A description is given of investigation, chiefly on cotton, wool, and silk, with an

apparatus called a turgometer, which allows accurate measurements to be made of the extent of swelling in fibres and other biological structures, produced by various strengths of reagents at various temperatures. Most of the work is done with caustic soda and sulphuric acid. Graphs are given showing the relation between time of immersion and turgometer readings for different strengths of solution on various states of fibre with different immediate pre-treatments, such as hot or cold water steeping. These show that the swelling occurs with hydration and is greater with more pronounced hydration. Tables are given showing (1) Loss of weight with time of treatment; (2) Strength and elasticity results from different treatments; (3) The relation between swelling effects on a warp and a weft yarn after various boiling and bleaching treatments for different strengths of caustic soda solution. —L.I.R.A.

Cellulose: Action of Sodium Hydroxide. J. D'Ans and A. Jäger. *Cellulosechem.*, 1925, **6**, 137-151.

After reviewing some of the previous work on the absorption of sodium hydroxide by cellulose, new figures for the absorption by several kinds of cellulose are given. Experiments were carried out at 2° C. and 23° C., and the effect of salts (NaCl and Na_2CO_3) and alcohol also examined. The solubility and swelling of the celluloses in the sodium hydroxide solutions were also determined and found to be a maximum at 12% NaOH (volume %), and these figures used to correct the absorption results. A general representation of the equilibrium systems is then made by the triangle method, the three components being water, cellulose, and caustic soda. Among other possible systems, the existence of two compounds $(C_6H_{10}O_5)_2$ NaOH and $(C_6H_{10}O_5)$ NaOH, is indicated. —B.C.I.R.A.

Pentosans: Estimation. W. Gerish. *Cellulosechemie*, 1925, **6**, 61-74 and 81-93.

The paper is a detailed description of the various methods for estimating pentosans. It is divided into three sections. Section A deals with comparative tests applied to the distillates obtained by distilling the carbohydrates or wood with hydrochloric acid by the Tollens method. Under this heading are discussed the following—(1) Colour reactions of various pentosans with (*a*) aniline acetate, (*b*) resorcinol, (*c*) peptone, (*d*) β-naphthylamine. The colour reactions serve to identify the pentosans, and by plotting a curve showing the intensity of colour obtained at intervals during the distillation, as measured by the quantity of distillate collected, the course of the hydrolysis can be followed. Such curves are plotted for xylose, rhamnose, cellulose, starch, saccharose, and for beech and pinewood pentosans, using aniline acetate as reagent, and the results are interpreted. Comparative tests are carried out with pure oxymethyl furfuraldehyde. (2) Colour and precipitation reactions, using (*a*) phloroglucinol and examining the alcoholic solution of the precipitated phloroglucide, (*b*) barbituric acid. (3) Investigation of the early stages of the distillation of wood with hydrochloric acid by the qualitative methods above described.

Section B deals with the application of different quantitative methods of estimating pentosans of wood. In this section are described—(4) Gravimetric methods, using phloroglucinol, barbituric acid, semioxamazide. (5) Volumetric methods of possible application, using ammoniacal silver solution, bromides, &c.

Section C deals with an investigation of the course of the distillation with hydrochloric acid (Tollens method). Under one heading are described—(6) The fractional distillation of beech wood and gravimetric determination of the pentosans, using phloroglucinol and barbituric acid. The amount of furfurol obtained in the several fractions, calculated to percentage of furfurol in dry wood, is shown graphically in both instances. (7) A method of distillation using not the Tollens method, but one in which no addition of hydrochloric acid is made during the reaction. The results are discussed and compared with those obtained by the Tollens method. The author's experimental results are set out in detail in the latter part of the paper, together with a summary of the deductions to be drawn from the results. —B.C.I.R.A.

Sugars: Rapidity of the Oxidation of, by Permanganate. R. Kuhn and T. Wagner-Jauregg. *Berichte*, 1925, **58**, 1441-1447.

An investigation of the rate of oxidation of various sugars by permanganate, including a comparison of the α, αβ, and β modifications of the sugars. —L.I.R.A.

Doubled Yarn: Testing. P. Luc. *Rev. Textile*, 1924, **22**, 435-439, 543-549.

A detailed scheme of tests to be employed for the examination of a doubled cotton yarn, as regards number and twist of singles yarn, doubling twist, breaking load, extensibility, &c., and as to whether the yarn is bleached, mercerised, gassed, &c. Certain spinning data are given for copying the yarn under examination.

—B.C.I.R.A.

Analysis of Water for Dyeing. *L'Avenir Textile*, 1925, **7**, No. 11, pp. 556-558.

A scheme of analysis is given for the estimation of ammonia, nitric acid, salt, manganese, iron, calcium, magnesium, sulphuric acid, and hardness of water intended to be employed in the dyehouse. —L.I.R.A.

Strength of Single and Double-carded Jute Yarns. See Section 2D.

Bleaching Damage Index. See Section 4G.

Oxidation of Indigo. See Section 4I.

Viscosity of Soap Solutions. See Section 5.

PATENTS

Powdered Cotton: Preparation. Farbenfabriken vorm. F. Bayer & Co., K. Mersenberg, and W. Lenhard. D.R P. 403,783 (from *Chem. Zentr.*, 1925, **i.**, 1663).

Cotton is prepared by milling in powder form, in which it is very suitable for carrying out chemical reactions, such as etherification and esterification; the cotton is not changed chemically. —B.C.I.R.A.

Starch Calcium Chloride Compound: Preparation. E. Felheim. D.R.P.406,820 (from *Chem. Zentr.*, 1925, **i.**, 1821).

Starch (7-8 parts) is mixed with crystalline calcium or strontium halides (7 parts), and water (3 parts), the quantities being so chosen that the paste first formed changes on standing into a damp mass which can be easily powdered. By limiting the quantity of water employed, the formation of viscous, ropy, plastic masses is avoided. Experiments showing the use of calcium and strontium chlorides are described. The white loose powdery products are not hygroscopic. —B.C.I.R.A.

Grain Drying Ovens. H. J. Denham. G. Watts, and H. Simon, Ltd., Manchester. E.P.239,637.

In testing the moisture content of cereals, &c., an electrically-heated oven is employed in which a sample is treated with a current of air heated to a high temperature which may reach 150°. The heaters are located in passages surrounding the oven, air being admitted at one end to lateral passages, returning by a passage beneath the oven and passing along an upper passage to the interior of the oven by a series of apertures. A fan or an additional heater may be located in a flue to assist the circulation. Sliding or other doors are provided at both ends and a series of samples carried by trays may be passed through by intermittent movements, a clock being employed to signal the time for the introduction of a fresh sample. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Grading—

239,368. F. Ellis. Fabric measuring device.

7—BUILDING AND POWER

(A)—CONSTRUCTION OF BUILDINGS

Effluents from a Bleaching and Finishing Works in Offenhausen (Bavarian Swabia); An Installation for the Purification of the——. C. Bochter. *Melliand's Textilberichte*, 1925, **6**, 821-823.

This works has an unlimited supply of spring-water. It was desired to get rid of the effluents by allowing them to soak into the soil, but in order to avoid contaminating the water supply it was decided to purify the effluents before their discharge on to the land. The installation provided for this purpose is described and is capable of dealing with 400 cubic metres of effluent per working day of eight hours. It consists of (*a*) tanks where the effluents are mixed and neutralised by the addition of milk of lime or sulphate of alumina, as required, (*b*) sedimentation tanks, and (*c*) an arrangement for biological purification. —L.I.R.A.

(C)—POWER

Textile Machinery: Power Consumption. *L'Avenir Text.*, 1925, **7**, No. 8, pp. 364-367 (from *Industria Tessile e Tintoria*).

A general article on the power consumption of textile machinery and some causes of excessive consumption. A table is given showing the power requirements, under normal conditions, of each type of machine from the bale-breaker to spinning and doubling frames. —B.C.I.R.A.

Calenders; Driving of——. P. Weiske. *Papier-Fabr.* (Fest-und Auslandh), 1925, **23**, 69-88.

Various electrical systems of driving calenders are discussed in relation to cost and economy in upkeep. —B.C.I.R A.

Loom Driving Motor: Application. C. Brunet. *Rev. Textile*, 1924, **22**, 151-161, 257-263.

A survey of the different types of motor available, their performance, efficiency, and the power factor, &c., of an electric installation. The relative merits of installing a single high-power motor and transmission system to drive a number of looms, or a single motor for each loom, are discussed, and it is concluded both from the point of view of weaving and of motive power that installation of a number of single unit is preferable to transmission. The author also discusses the general conditions which must be satisfied by an electric motor for all types of looms, and proceeds to describe four types of drive which are employed accordingly as the loom action is reversible, intermittent, or entirely regular. The four types are—(1) Simple gear wheel drive, (2) belt drive, (3) combined gear and belt drive, (4) a drive with a friction connection and centrifugal engagement. The several advantages of the first three types are discussed, in each case under the headings (*a*) control when starting up the loom, (*b*) adjustment by a gear reduction device of revolutions of motor to speed of loom, (*c*) space occupied in relation to maximum accessibility of loom parts, (*d*) change of speed of loom, (*e*) control and maintenance, (*f*) noise, (*g*) accident risks, (*h*) price and efficiency. The fourth type of drive, which is only used

for special purposes, and its advantages in instantaneous starting or stopping of a loom, regularity of action, &c., are described. —B.C.I.R.A.

(F)—Lighting

Reflecting Lamps. *Melliand's Textilberichte*, 1925, **6**, 496.

The firm of Carl Zeiss have placed on the market a series of reflecting lamps, each of which is suited to a special purpose, such as reading lamps, display window lamps, and work and machine-room lights. The lamps are said to combine maximum illumination with economy of current. —B.C.I.R.A.

(H)—Humidification

Apparatus for Humidifying Yarn at Low Pressure. H. S——. *Rev. Textile*, 1925, **23**, 1143.

The yarns to be humidified are on paper tubes and are placed on a suitable truck which is run into a low pressure chamber. The chamber is exhausted and steam blown in. The yarn is cooled in the saturated atmosphere. This causes water vapour which has penetrated the interstices in the yarn to condense. The plant described can humidify 1,500 kg. of yarn in two hours. —L.I.R.A.

The Measurement and the Automatic Control of Temperature and Humidity of Air for Spinning and Weaving. F. Kastner. *Leipsiger Monats.*, 1925, **40**, 282-285.

The importance of temperature and humidity in textile production is referred to. The instruments available for measuring and recording temperature are reviewed. A description is given of a therm-regulator which depends on a bent bi-metal strip changing its curvature with temperature. This operates a valve for compressed air, which is used as a relay to control the steam or hot-water supply for heating. Instruments for measurement of humidity are described, amongst which is a sensitive hygrometer using a series of thermo-junctions in place of the wet and dry bulbs. An apparatus for control of humidity is referred to, its working being parallel to the thermo-regulator, a hair or other material sensitive to humidity taking the place of the bimetallic strip to control the means of humidification through the relays. —L.I.R.A.

Air-conditioning for Weaving. E. Ulrich. *Leipsiger Monats.*, 1925, **40**, 433-435.

Humidification by sprinkling water over a tiled floor is recommended, but a suitably absorbent floor material is liable to get stained with oil falling from the looms. A description of three kinds of humidifiers is given. The first employs a wet cloth hanging from a trough of water under the warp on the loom. Water is fed along the cloth by capillary action and evaporation takes place near the yarn beam, thereby increasing the air humidity and consequently the water content of the yarn. The second uses a fan to suck air through a valve on to a radiator, and through a water spray, the spray being formed by forcing water through small nozzles. By this method temperature and humidity can be controlled. The third uses a tank and ball valve. The tank can be raised or lowered to vary the flow of water to a nozzle over which the air is blown. Some aspects of ventilation are discussed. —L.I.R.A.

Relative Humidity and Dew-point Relations. See Section 4E.

Moisture Relations of Fibres. See Section 6.

9—COMMERCE, ECONOMICS, LABOUR &c.

Cotton Production in Brazil. E. Schultze. *Leipziger Wochens. Text. Ind.*, 1925, **40**, 150-151, 182-183, 212-213, and 248-249.

A survey of the production and consumption of raw cotton and of the imports and exports of Brazil. Home consumption is increasing much more rapidly than cultivation, and the amount of raw cotton available for export is inconsiderable. Export, spindle, and production figures are submitted. —B.C.I.R.A.

Indian Cotton: Cost Factors. W. Kuske. *Leipziger Wochens. Text.-Ind.*, 1925, **40**, 243-244.

The high price of Indian cotton is attributed to high cost of production and to gold inflation, and the relation of the latter factor to cost is discussed. —B.C.I.R.A.

Artificial Silk Production in Germany from 1900-1913. C. Königsberger. *Kunstseide*, 1925, **7**, 203-206.

An account of the development of the German artificial silk industry during the years 1900-1913. The names of principal manufacturers are given with particulars of their financial standing and the nature of their production. Figures showing the average consumption of artificial silk in the various industries for the years 1911-1913 are given. —B.C.I.R.A.

Artificial Silk: Production. W. A. Dyes. *Kunstseide*, 1924, **7**, 8-10, 32-37, and 121-124.

A brief economic review of the world's artificial silk industry, with estimates of 1927 production by countries. In discussing the cuprammonium process the author gives lists of relevant American patents and of recent patents taken out by the A.-G. Bemberg, of Barmen, and shows how the process has been superseded by the viscose process, except where the

production of filaments of high denier is required. The author discusses the position of the British Celanese Co. and of acetate-silk manufacture in England. He gives an account of the Chardonnet process in Belgium, with a note on the Tubize Co., of Brussels, and its capital ramifications, and gives a more detailed account of the viscose position in England, America, Germany, and Italy. —B.C.I.R.A.

Artificial Silk Production in Italy. *L'Avenir Text.*, 1925, **7**, No. 6, p. 14.

The Snia-Viscosa Co. is increasing its capital to 1,000 million lire, and is erecting new works at Turin. Production in Italy reached about 9 million kilos. in 1924, of which about 5,600,000 kilos. were exported, including 1,600,000 kilos. to Great Britain. Imports of artificial silk were only 694,000 kilos. in 1924. —B.C.I.R.A.

Indian Cotton Bales: Identification Marks. *Indian Text. J.*, 1925, **35**, 342.

Rules recently issued by the Government of India require all cotton-pressing factories in British India to punch on the hoop of each bale pressed the special mark allotted to the factory and two numerals denoting the cotton year in which pressed. The running number of the bale may either be punched on the hoop or stencilled on the hessian. The special press mark consists of a letter denoting the Province and a number, and letters and numbers must be not less than ¼ inch in length. A list of the Provinces is given, with their prescribed letters, and the approximate number of presses in each. —B.C.I.R.A.

Reducing Cost of Raw Materials in the Hemp Industry. K. Yourkin. *Review of the Text. Trade and Ind.*, 1925, **1**, No. 10, p. 7.

It is not sufficient to reduce the variety of articles manufactured or to standardise and improve production in order effectually to reduce production costs in the hemp industry. It is also necessary to find a way of reducing the cost of raw material. Attention must be given to the preparatory work of pulling, retting, and scutching. Reduction could be effected by treating the plant properly before it is delivered to the market. At present peasants pull the hemp without separating it from the roots—to save time and to make their parcels heavier. In such hemp the fibre near the roots is coarse and unsuitable for manufacturing purposes and therefore before it can be used by the machines, it must be cleaned of the roots in the factory itself. In each lot delivered to the factory about 15% of defective hemp, such as described above, is to be found on the average. This largely accounts for the high cost of raw material. The following particulars give an idea of how different charges, due to inefficient treatment of the plant, add to the cost of raw material—

	r.	k.
Say the cost of 1 pood of hemp at the place of production is ...	7	0
Binding and baling expenses ...	1	0
Cost of delivery	0	45
Total ...	8	45

Bindings, made of tow, amount to 1% of the total weight. They are charged at the same rate as hemp, but their real value is only 35% of the price of fibre, and that adds 6 kopeks to the price of 1 pood of raw hemp.

There is 15% difference in weight, owing to the cutting away of the coarse roots, which adds another 94 kopeks. The cost of labour for cutting away the roots adds another 25 kopeks, so by the time the fibre is delivered to the factory and made ready for use, the price of 1 pood of raw hemp is 9 r. 70 k. Thus it has increased by 2 r. 70 k. or 39% from the time it left the producers. Of this amount 1 r. 19 k. or 17% increase is due to the presence of the coarse root ends. By eliminating this defect the position would be improved immediately. At present there are no regulations as to the required standard of raw hemp. The introduction of such regulations and the announcement of a premium for the cleanest hemp fibre delivered would be the best means of combating the evil of high costs of raw material.

—Text. Synd., U.S.S.R.

10—MISCELLANEOUS

Daylight Spectacles. E. Belani. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section) 1925, **23**, 662-664.

A description of a light filter mounted in the form of spectacles, made by the Lumina Gesellschaft, and based on Ives' researches with a 1-watt metal filament lamp, measured spectrophotometrically against daylight. Ives found that in the region of $\lambda=420$, the light intensity of the lamp was equal to that of daylight (=unity). From a curve obtained by plotting light intensities of the lamp against wave length, a curve was derived correcting the lamp intensities to daylight intensities. The filter constructed to the derived curve Ives named the "ideal daylight filter" of the vacuum lamp, and forms the basis of the lumina spectacle filter. The properties of the various coloured glass filters in common use are discussed in the article, and their inferiority to the ideal daylight filter of Ives shown graphically. —B.C.I.R.A.

Textile Schools in France and Belgium. A. Helle-Staux. *Rev. Textile*, 1924, **22**, 479-486.

The courses in textile technology provided at the school at St. Quentin and its subsidiary at Bohain are described. New premises were opened in 1923. The Ecole Supérieure des Textiles, at Verviers is described as regards curriculum, and illustrations are given of the factory scale wool cards, spinning frames, and looms possessed by the school. —B.C.I.R.A.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Study of the Secretion of Silk by Means of the Ultra-Violet Rays. A. Policard and A. Parillot. *Compte Rendus*, 1925, **181**, 378-380.

When a silkworm about to spin is examined by ultra-violet light (ray of wave length 3,650A.), a brilliant fluorescence is shown on several parts of the body, which disappears after the cocoon has been spun. The cause of the phenomena has not been completely ascertained. —B.S.R.A.

Silkworm Raising by Old Methods. *Silk Jl.*, 1925, **2**, No. 15, p. 55.

In spite of the efforts of sericultural schools in South China, most of the silk is produced in the homes of the peasantry, where it cannot be kept properly clean and disinfected. The worms are reared in the living-room, and fed on dirty, wet, or over-dry leaves, and consequently catch various diseases. Owing to shortage of labour, neglect of feeding and cleanliness lead to spoiling of whole crops. Thermometers are unknown, and therefore the regulation of temperature is so haphazard as to cause more harm than good. Of the eight diseases of silkworms in Nanking, two are caused by damp leaves, three by rotting leaves, one by irregular feeding, one by contaminated leaves, and one by inheritance. Some diseases are caused by fly-bites. Although these causes can all be remedied, the farmers call them "plagues," and let it go at that. Mulberry leaves are bought in the winter for delivery in May. —F.G.P.

Silk Raising in Mexico. *Silk* (N.Y.), 1925, **18**, No. 6, p. 82.

A company has been formed, under Government supervision, to rear silkworms and reel silk. Twenty-five Italian families used to the work are to be brought in to teach the Mexicans. Italian machinery will be used. It is thought that with the cheap labour and the exceptional climate of Mexico that silk production will be a financial success. Government land is to be planted. —F.G.P.

A New Aspect of Merino Breeding and Wool Combing. J. E. Duerden and V. Bosman. *Wool Record*, 1925, **28**, 1,222.

The results of biological analysis are illustrated by means of graphs, which show that in most samples of merino wool a few fibres occur which are coarser than the general bulk, and interfere with the perfect evenness of the manufactured cloth. They are often four or five times thicker than the finest fibre in the same staple, and it is suggested that if they could be eliminated either by breeding or combing the wool would rise in quality, and at the same time uniformity of type would be gained. In the higher qualities the contrast may be barely discernible, but becomes more marked in the lower qualities. Attempts have been made to add a suitable device for removing the outside fibres in the process of combing, but mechanical difficulties remain unsurmountable. Hence the problem of attaining the same degree of purity not only of the fine but also the coarse fibres falls back on the breeder. Careful and intelligent selection of the sheep and examination from the point of view of the outside fibres is recommended. —B.R.A.W. & W.I.

Effect of Water on Constitution of Wool. S. R. Trotman and others. *J. Soc. Chem. Ind.*, 1926, **45**, T.21.

A paper on the nature of the proteins of wool dealing with the action of alkalies and acids upon it, and also the effect of water at high temperatures. At sufficiently high temperature and pressure the wool goes into solution with evolution of H_2S. Wool treated at two atmospheres pressure for one hour left an undissolved residue, brownish and brittle, with a very low tensile strength. The chemistry of chlorination is also discussed. —B.L.R.A.

(C)—Vegetable

Cotton Cultivation in Argentina. H. Seckt. *Faserforschung*, 1925, **4**, 195-197.

Cotton has been cultivated in Argentina for about 20 years. Previous attempts were made, but were abandoned, and it was only in 1906 that a report was made to the Ministry of Agriculture urging the excellence of the climatic and soil conditions for the growth of cotton, and recommending the trial of short and medium stapled cottons in the Chaco, Corrientes, and Salta districts. Since that time cotton cultivation has developed chiefly in the Chaco, in the area served by the State railway. Simultaneously with the extension of cultivation a series of related industries has sprung up, such as ginning, spinning and weaving and cottonseed oil recovery. Climatic and soil conditions over about one-third of Argentina are suitable for the growth of cotton. The territory of the Parana River, particularly the Chaco, is the most suitable. The yield per hectare is at present low, due partly to locusts and partly to inexperience. Argentina cotton is suitable for the production of coarse yarns. —B.C.I.R.A.

Cotton Plant Growth in Turkestan. G. S. Zaitzev. *Bot. Abstr.*, 1925, **14**, 960 (from *Bull. Appl. Bot. and Plantbreed*, 1922-1923, **13**, 391-460).

Observations made on flowering, fruit formation, and dehiscence of the cotton plant are detailed. Since the vegetative period of cotton is very short in Turkestan, where the experiments were made, varieties which ripen early must be bred. A direct correlation was found between the period of sowing to flowering and the period of sowing to maturity, the coefficient of correlation being +0·875. The appearance of the buds and the opening of the flowers proceed in a definite order. Flowering begins with the first flower of the first sympodium, and successively, at intervals of 2-3 days, the first flowers on the second, third, &c., sympodia begin to open. The second flower of the first sympodium opens 5-7 days after the first flower does, the third opens after an equal interval, and so on. The appearance of successive flowers on other sympodia follows the same order as described for the appearance of first flowers. The author develops formulæ by which it is possible to calculate the number of flowers present at any given time on a plant. An experiment showed that 10 hours after pollination one-half of the pollen-tubes had had time to pass through the whole length of the style (17 mm.). The shading of the flower affects the development of the fruit, in that it reduces the number of seeds formed, reduces the weight of the seed, and also the length of the hairs. The shedding of bolls increases in the direction from bottom to top, and still more from the centre laterally. Artificial self-pollination in general reduces the rate of shedding by 20%, and also increases the number of seeds formed in the fruit. Under Turkestan conditions natural crossing approximates 5%. For all the varieties of cotton, differing in early maturity, there exists a definite relation between the periods sowing to flowering and flowering to dehiscence of bolls. Under Turkestan conditions the relation is $40x : 60x$, where x is a variable characteristic for each variety.

—B.C.I.R.A.

Asiatic-American Cotton Hybrid. G. S. Zaitzev. *Bot. Abstr.*, 1925, **14**, 1184 (from *Bull. Appl. Bot. and Plantbreed*, 1922-1923, **13**, 91-115 and 117-134).

Of many previous endeavours to cross cottons of the Asiatic and American groups the only successful one is said to have been that of Gammie, who worked with *Gossypium arboreum roseum* and *G. hirsutum*. A. G. Nikolajeva found the somatic cells to contain 26 chromosomes in the Asiatic group and 52 in the American group. The author conceived that the failure of most attempts was owing to the slow rate of growth of the tubes of the foreign pollen and the early dehiscence of the style. By removing corolla and staminal column in the bud, the receptiveness of the pistil was prolonged, and application of pollen of an okra-leaf type of *G. hirsutum* to pistils of *G. herbaceum* resulted in the setting of seed. The F_1 was intermediate in most respects, but the dominance of the male parent was shown in two characters, and heterosis also was shown. More than 500 flowers were produced by F_1 plants but none self-fertilised, all having been shed a few days after anthesis. Reciprocal cross pollinations of hybrid with either parent and with other representatives of the two groups were equally unsuccessful. This is attributed to imperfect maturation of pollen (and probably also of egg cells) of the hybrid. Reviewing the results, the author suggests that it may be possible to obtain viable seed from the hybrid plants by making cross-pollinations early in the season, on a more extensive scale, when shedding is less severe. —B.C.I.R.A.

Cotton Cultivation in the Belgian Congo. M. Schantz. *Bot. Abstr.*, 1925, **14**, 1048 (from *Tropenpflanzer*, 1921, **24**, 49-52.

Areas along the Upper Congo and such places where a regular rainy period is followed by three or four months of drought, which guarantee a good ripening and drying harvest, are best adapted to cotton raising. The best varieties for this region are Triumph Big Boll and Simpkins' Early Prolific. Natives are being taught cotton growing, and their harvests are bought at a certain price.

—B.C.I.R A.

Cotton Cultivation in U.S.A. (Oklahoma). *Exp. Sta. Rec.*, 1925, **53**, 132 (from *Oklahoma Sta. Bien. Rpt.*, 1923-1924).

Cotton with tops mowed off rather low made 237 lbs., with squares removed during July 481 lbs., topped cotton 544 lbs., and untreated plots 693 lbs., all per acre. Yield differences between unthinned and cotton spacings up to 24 in. apart have been slight. Varietal leaders have included Oklahoma Triumph 44, Half-and-Half, Mebane, Burnett, and Acala.

—B.C.I.R.A.

Cotton Boll: Shedding. *Exp. Sta. Rec.*, 1925, **53**, 150 (from *Oklahoma Sta. Bien. Rpt.*, 1923-1924).

The results of a greenhouse study of the cotton plant relative to boll shedding are given. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (South Carolina). *Exp. Sta. Rec.*, 1925, **52**, 531-532 (from *South Carolina Sta. Rpt.*, 1924).

Although closely spaced cotton was little earlier then widely spaced, during a very wet season the earliest and best yields come from spacing as close as 9 or 12 in. A spacing yielding 15,000 to 20,000 plants to the acre is the best, when an average of from 5 to 6 mature bolls will yield a bale to the acre. Acid delinted seed again

excelled. Seasonal conditions affect the rate of hardening of the bolls, and they also seem to influence the period from the flower bud to the mature boll. A very definite correlation exists between the length of day and the boll period. Abortion of early buds and squares, evidently connected in some way with the unusually rainy season, is also commented upon. Topping late in the season had little effect on yield, but the topped cotton seemed to open earlier and better than untopped plants. Results of fertilisation, variety, and time of planting tests are also given. —B.C.I.R A.

Boll Weevil Investigation in U.S.A. (Carolina). *Exp. Sta. Rec.*, 1925, **52**, 559 (from *South Carolina Sta. Rpt.*, 1924).

Of boll weevils placed in hibernation on 8th September, between 1st October and 16th, between 16th and 31st October, and between 1st and 13th November, the survival percentages were respectively 0·02, 0·19, 59·00, and 2·45. These data are considered to emphasise the importance of stalk destruction. Details of varying phases of life cycle, migration, and boll weevil parasites are given. Plots which were arsenic dusted as soon as infestation reached 10%, yielded at the rate of 2,000 lbs. seed cotton per acre.

—B.C.I.R.A

Cotton Waste; Sources of——. A. Richter. *Melliand's Textilberichte*, 1925, **6**, 642-643.

Some general notes on the different kinds of cotton waste arising from the different processes of cotton manufacture, and a short note on the mechanical treatment of cotton waste to improve its quality. —B.C.I.R.A.

Cotton Cultivation in California. O. F. Cook. *J. Heredity*, 1925, **16**, 335-338.

The advantages of community production are now so well recognised that legal protection is being given to one-variety communities against the danger of mixture and impairment of seed-stocks. Acala cotton is the variety selected for community growth. A second law provides for the certification of pure cotton seed by the California Department of Agriculture. —B.C.I.R.A.

Cotton Plant: Manuring. W. H. Appleton and H. B. Helms. *J. Amer. Soc. Agronomy*, 1925, **17**, 596-605.

Greenhouse experiments on the rate of absorption by cotton of nitrogen applied in the form of sodium nitrate are described. The nitrate was applied at the rate of 600 pounds per acre, 14, 40, and 61 days after planting, and absorption was complete in 36, 14, and 11 days respectively. Thus, when nitrate is applied to cotton 14 days after planting the plants are not sufficiently developed to absorb it rapidly, and considerable amounts may be lost by leaching. Such loss may be diminished considerably by delaying application to a later stage of growth. —B.C.I.R.A.

Cotton Plant in the U.S.A.: Effect of Time of Planting. W. W. Ballard and D. M. Simpson. *U.S. Dept. of Agriculture Bull.*, No. 1320, 1925, 43 pp.

In the season of 1923 comparisons were made of the behaviour of early and late plantings in three widely separated parts of the Cotton Belt. The cotton was planted on four different dates, and measures were taken to prevent the infestation of early plantings by overwintered weevils. Differences were shown in the rates of growth and fruiting habits of the plants. A more rapid formation of nodes during the seedling stage was found to occur in the later plantings, resulting in a shorter interval between the date of planting and the appearance of the first floral bud. The fruiting capacity of late-planted cotton was found to equal, and in some cases exceed, that of early-planted cotton. The large number of floral buds produced in later plantings was due to the fact that more nodes were produced on the lower fruiting branches. Also, slightly larger numbers of flowers were recorded on the late-planted cotton, although early plantings produced a larger number of flowers during the first part of the flowering period. A separate late planting made at San Antonio showed that thinned plants had a larger individual fruiting capacity than unthinned plants, the difference being counterbalanced, however, by the greater number of plants in the unthinned rows. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (Texas). G. N. Stroman. *Exp. Sta. Rec.*, 1925, **52**, 533 (from *Texas Sta. Bull.*, 321, 1924.

The relative rank of the leading varieties 1912-1922, was Belton, Tavitt, Acala, Lone Star, Rowden, Durango, Kasch, Mebane, and Bennett. These are considered standard varieties for this section of the State. Averaging production from 1917-1922 showed the order to be Acala, Lone Star, Rowden, Durango, Mebane, Kasch. High yields seem to be correlated with well distributed rainfall, especially during June, July, and August, while the total annual rainfall was apparently without effect on yield. —B.C.I.R.A.

Pink Bollworm: Occurrence in Australia. E. Ballard. *Rev. Appld. Entomology*, 1925, **13**, 518 (from *J. Econ. Ent.*, 1925, **18**, 641-642.

Two well-defined races of *Platyedra gossypiella* are established in Queensland, one occurring on species of wild *Hibiscus* and not having been found on cotton. It differs from the typical form in being more deeply and evenly coloured in the crotchets

of the forelegs forming a pattern of two opposite arcs and not a complete horseshoe, and in the very marked chitinisation of the setiferous plates. The larvæ from Western Australia and the Northern Territory belong to the typical form. The present situation in Queensland is reviewed. Only three gins are in use, so that a fairly good record can be kept of any new areas which become infested. Vigorously applied legislation, or co-operation on the part of the farmers would keep the pest in check, but in present circumstances it can only be hoped to prevent its spreading to uninfested areas. —B.C.I.R.A.

Cotton Production in U.S.A. (Salt River Valley). *Exp. Sta. Rec.*, 1925, **53**, 235 (from *Arizona Sta. Timely Hints for Farmers*, No. 150, 1925).

Of the 1924 crop on about 138,000 acres only 8,000 acres were under Pima. An increase of 14% acreage occurred in 1925, bringing the total to 157,300 acres, of which 39% was under Pima, 33% Acala, 12% Hartsville, and 10% Mebane. Cultural data and yields for these varieties on six soil types are also given.

—B C.I.R.A.

Cotton Cultivation in U.S.A. (Georgia). *Exp. Sta. Rec.*, 1925, **53**, 230 (from *Georgia Sta. Rpt.*, 1924).

The leading varieties included Deltatype Webber, Salisbury, Acala, and strains of Express, Cleveland, and Delfos. Application of paper mulch after the first cultivation without further culture seemed to result in an increase of 764 lb. of cotton.

—B.C.I.R.A.

Cotton Cultivation in U.S.A. (Georgia). R. R. Childs. *Exp. Sta. Rec.*, 1925, **52**, 634 (from *Georgia Agr. Col. Circ.* 104, 1925).

Strains of College No. 1, Cleveland, and Express produced the highest acre yields and value in the 1924 variety tests. Fairly close spacing made the highest yields in spite of extremely wet weather. While bolls were slightly smaller in unthinned and 7 in. spacings, no appreciable difference was found in length or percentage of lint at the different spacings. Acid-delinted seed germinated better, and produced a better stand than untreated seed in 1924. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (South Mississippi). *Exp. Sta. Rec.*, 1925, **53**, 33 (from *Mississippi Sta. Circ.*, 56, 1924).

Delfos, Trice, Lone Star, and Express have led in average value during the period 1921-1924. Fertiliser, spacing, and time of planting experiments are also recorded.

—B.C.I.R.A.

Cotton Cultivation in U.S.A. (Mississippi). *Exp. Sta. Rec.*, 1925, **53**, 234 (from *Mississippi Sta. Bull.*, 226, 1924).

Cork and Cleveland have produced the largest average yields during recent years and Delfos and Trice have led in value. The varieties are ranked according to wilt resistance, and those suited for poor hill soil are indicated. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (Missouri). *Exp. Sta. Rec.*, 1925, **53**, 234 (from *Missouri Sta. Circ.*, 132, 1925).

In south-eastern Missouri, Trice and Delfos are indicated as best suited to the heavy soils, and Acala and Express to light sandy soils Fertiliser and spacing tests are included in the report. —B.C.I.R.A.

Flax; How to Prepare a Field for——. G. Glassen. *Bot. Abstr.*, 1925, **14**, 1249, (from *Cyprus Agric. Jour.*, 1925, **20**, 1-3).

Illustrations are used for the purpose of graphically depicting the relative root and stem growth of plants in poorly and well prepared seed beds. Attention is called to the different behaviour of plants grown from Belgian seed as compared with those produced from Cyprus-grown seed. The latter seem to have developed the acquired character of a shallow lateral root growth as compared with the deep tap root system of the Belgian seed. The author concludes his paper with two recommendations—(1) It is essential that the field be well harrowed in order to obtain a fine tilth. (2) The seed should not be covered with more than 1½ inches of earth, and no clods should be allowed to remain in the field unbroken. —L.I.R.A.

Seed Flax as a Farm Crop in 1925. A. C. Dillman, A. C. Arny, C. McKee, T. E. Stoa, and A. N. Hume. *Exp. Sta. Rec.*, 1925, **53**, 34 (from *U.S. Dept. Agric. Circ.*, 341, 1925).

The status of flax seed production is described, with statistics on production and consumption in the United States, acre income from flax, flax seed prices and the tariff, and on world production. Based on experimental results, the experiment station agronomists of North Dakota, Minnesota, South Dakota, and Montana, the leading flax producing States in order of production, have given information on production costs, crop sequence, varieties, cultural methods and field practices, and the merits of flax-wheat mixed cropping. Available departmental and station publications on seed flax are listed.

—L.I.R.A.

Flax and Hemp: Fibre Investigations in Canada. R. J. Hutchinson. *Exp. Sta. Rec.*, 1925, **53**, 134 (from *Canada Exp. Farms, Div. Econ. Fibre Prod. Reports*, 1921-22, 1923).

Variety and seeding trials and scutching, retting and spinning tests with flax, the relative value of different soil types for flax; experiments with new machinery and cultural and varietal trials with hemp, are reported on as heretofore (*Exp. Sta. Record*, **48**, 32). Flax grown at Agassiz,

B.C., and Kentville, N.S., produced the highest yields and the best quality of fibre, resembling the best grades of Irish. In the Ottawa tests, delaying the harvest of flax resulted in more and stronger fibre. Broadcasted flax gave slightly higher yields, while drilled flax was a little shorter, more uniform, ripened earlier, and showed a greater tendency to lodge. Seeding late after a week of dry warm weather gave the best results on heavy soil, and the fibre yield increased with seeding up to 110 lbs. per acre. Fibre obtained by the Kayser retting process was very green and harsh. Flax retted at over 68° F. appears to produce a greenish coloured fibre with reduced strength and spinning value. In machine hackling a difference of 12·88% in yield of line was in favour of water-retted fibre, but in the subsequent stages three-ply yarn and finished twine from dew-retted fibre had better tensile strength than those made from water-retted fibre. From dry flax straw in 1922 were obtained 8·2% of long fibre and 4·46 of tow, and the losses in deseeding amounted to 34·43%, in retting 16·23%, and in breaking and scutching 36·68%. Preliminary trials with hemp at Ottawa showed the superiority of Kentucky seed, the unsuitability of heavy clay soil for hemp, and the necessity of good drainage.

—L.I.R.A.

Flax in Oregon. G. R. Hyslop. *Exp. Sta. Rec.*, 1925, **53**, 235 (from *Oregon Sta. Circ.*, 1925, **60**, 3-10).

Practical information on the environmental and cultural requirements for seed and fibre flax growing in Oregon is given with comments on harvesting and retting.

—L.I.R.A.

Manila Hemp. P. Martell. *Leipsiger Monats.*, 1925, **40**, 462-464.

A brief description of the production, characters, and uses of Manila hemp.

—L.I.R.A.

Raising Fibre Plants in Sao Paulo. A. Grieder. *Bot. Abstr.*, 1925, **14**, 1249 (from *Tropenpflanzer*, 1922, **25**, 69-72).

Sao Paulo is well suited for raising fibre plants. The writer mentions especially among the native species—Kapok (*Ceiba pentandra*), lagetta fibre (*Funifera utilis*), tucumpalm (*Astrocaryum vulgare*), piassave (*Attalia funifera*), para-piassave (*Leopoldina piassava*), paranut (*Bertholletia excelsa*), and *Cecropia peltate.* In the "Economical Notes on Brazil," published by the Brazilian Department of Agriculture, cotton is mentioned as a fibre plant. Among the well-known fibre plants grown in various regions of Sao Paulo are the following species—Sisal, Piteira (*Fucræa gigantea*), screw pine (*Pandanus utilis*), ramie (*Bœhmeria nivea*), hemp (*Cannabis sativa indica*), flax, roselle (*Hibiscus sabdariffa*), tupichahu (*Hibiscus sabdariffa* var. *camensin*), Brazilian hemp (*Hibiscus ferox*), sunn (*Crotalaria juncea*), jute (*Corchorus capsularis*), and *C. olitorius* and aramina (*Urena lobata*). The growing season starts either in September or October or from March until May. Harvest takes place from December to March, or from June to August. Fifteen to twenty-four kg. of cotton are used per ha., 100 to 160 kg. of flax, 60 to 90 kg. of Brazilian hemp, and 30 to 60 kg. of Indian hemp. Sao Paulo went through a severe crisis on account of the coffee production, and it is therefore advisable to grow several kinds of crops.

—L.I.R.A.

Weed Elements in the Seed Material of Saratov Province. E. A. Stoletova. *Exp. Sta. Rec.*, 1925, **53**, 36 (from *Bull. App. Bot. and Plant Breeding*, 1922-23, **13**, 283-353).

Examination of seed samples at the Saratov Seed Testing Station showed that the weed seeds most frequently found in samples of flax seed used for sowing in that province were *Chenopodium album*, *Camelina sativa*, and *Polygonum convolvulus.* —L.I.R.A.

Boll-weevil Control in S. Carolina. See Section 9.

(D)—Artificial

Cellulose Suspension: Preparation, and Volume Determination. C. G. Schwalbe and G. A. Feldtmann. *Chem. Zentr.*, 1925, **i.**, 1925 (from *Wochbl. f. Papierfabr.*, 1925, **56**, 251-256).

Cellulose in fibrous form is brought into a fine state of division in water by shaking with acetic acid to which Turkey red oil has been added. After a definite time the volume of the cellulose deposited is read off. The determination of sediment volume can be used to detect differences in certain properties of the celluloses.

—B.C.I.R.A.

Cellulose XVI.: Crystalline Cellulose Acetates. ii. K. Hess, G. Schultze, and E. Messmer. *J. Soc. Chem. Ind.*, 1925, **44**, B841 (from *Annalen*, 1925, **444**, 266-287).

The cellulose acetate, soluble in acetone, insoluble in chloroform (Bayer's "cellite"), prepared on the large scale by partial hydrolysis of cellulose triacetate with sulphuric-acetic acid (G.P. 252,706) is found to be a mixture of triacetate and isomeric diacetates in the ratio 1: 4, together with acetates of dextrose and cellobiose. The rate of acetylation varies very considerably with different cellulose preparations, the time required ranging from 1¼ hours for Kahlbaum's "defatted" cotton to above 48 hours for mercerised "linters." Mercerisation cannot therefore be regarded as a depolymerisation, but is rather a surface polymerisation effect. A further result of mercerisation is the much slower hydrolysis of triacetate in solution to diacetate. After about six precipitations

from benzene-alcohol, the mixture of tri- and di-acetates shows signs of crystallisation, and well-defined crystals are eventually obtained. These are stable only in contact with the solvent, and become amorphous when dry. Like the triacetate crystals, they show no X-ray line spectrum. That the crystalline acetate is derived from chemically intact cellulose is proved by the identity of the rotatory power curves in ammoniacal copper solutions (see following abstract) for the hydrolysed product and for pure cotton cellulose. No separation of cellulose into two or more isomerides results even after prolonged fractional crystallisation of the crystalline tri- and di-acetates, nor after fractional extraction with chloroform.

—L.I.R.A.

Cellulose XVII. Characterisation of Cellulose Preparations. K. Hess, E. Messmer, and N. Ljubitsch. *J. Soc. Chem. Ind.*, 1925, **44**, B841 (from *Annalen*, 1925, **444**, 287-327).

When the rotatory power of solutions of a cellulose in ammoniacal copper solution is plotted against the copper or $C_6H_{10}O_5$ concentration, a characteristic curve is obtained, which is entirely different from the curves given by similar solutions of sugars and their derivatives or of other polysaccharides. Identical curves are obtained for (1) wood-cellulose, (2) its alkali-soluble portion, (3) "α-cellulose" (the alkali insoluble portion), and (4) purest cotton-cellulose. These must hence be regarded as a single chemical individual, their differences being attributable to physical causes (e.g., differences in surface conditions). In a similar manner the identity of American and Egyptian cotton-celluloses is demonstrated, and Venn's conclusions are shown to be erroneous. Ramie-cellulose, although it contains 5% of matter soluble with difficulty in ammoniacal copper solution, is nevertheless composed of chemically pure cellulose. Mercerised cotton is purer than before mercerisation. The hydrocelluloses and cellulose dextrins give curves of the same type as that for pure cellulose, though the presence of hydrolysis products leads to smaller lævorotation. —L.I.R.A.

The Alkali Cellulose Problem. R. Lorenz. *Chem. Abstr.*, 1925, **19**, 3016 (from *Wochbl. Papierfabr.*, 1925, **56**, 23-35).

A critical discussion of recent researches on alkali cellulose. Experiments on the action of 0·01-0·001 normal sodium hydroxide on pure cellulose (filter paper) show that with increasing dilution relatively more, although on an absolute basis much less, sodium hydroxide is absorbed by the fibres. Such behaviour is typical of adsorption reactions. Swelling of cellulose is regarded as due to hydration of ions. Maximum swelling occurs at the point of maximum conductivity of the solution. This weakening of the cellulose complex permits all kinds of adsorption phenomena. —L.I.R.A.

Determination of α-Cellulose. C. G. Schwalbe. *J. Soc. Chem. Ind.*, 1925, **44**, B984 (from *Papierfabr.*, 1925, **23**, 697-705).

The usual methods for the determination of α-cellulose give results which may vary by several per cent. when carried out by different workers. This may be due to variations in the room temperature, in the time of treatment with sodium hydroxide, and in the wetting of the fibre. The individual fibres of a sample differ in the ease with which they are wetted, and it is possible that the addition of a wetting agent, e.g., Turkey red oil, would be advantageous. Three new methods for the determination are described, and have been tested in a number of laboratories, but none of them is completely satisfactory

—L.I.R.A.

Artificial Silks: Physical Properties. K. Götze. *Melliand's Textilberichte*, 1925, **6**, 664-665.

In reply to Mesenholl, the author claims that German artificial silks, when compared with foreign artificial silks of the same denier number, are stronger than the latter. He states that at least 30% of the artificial silks quoted by Mesenholl are no longer on the market, and gives extensibility data for Elberfeld, Obernburg, Agfa, and Küttner artificial silks showing that the figures, which vary between 16·1 and 21·1%, are much higher than those given by Mesenholl, and higher also than the extensibilities of Enka, Snia, Tubize, and Chatillon artificial silks, which vary between 12·4 and 15·1%.

—B.C.I.R.A.

Artificial Silk: Action of Dilute Acids. W. Zänker. *J. Soc. Chem. Ind.*, 1925, **44**, B799 (from *Textilchem. u Color.* 1923, 85-89).

Dry cuprammonium and viscose artificial silk yarns after treatment with dilute sulphuric acid, whereby they retain 0·22% and 0·16% of sulphuric acid respectively, show an increase in breaking load of 9-10%, and this persists after subsequent dyeing. The treated yarns have their maximum tensile strength at 75° (the usual temperature of artificial silk drying chambers), but their strength sinks to normal with regain of moisture. —B.C.I.R.A.

German Rayon Production and Trade. *Text. Colorist*, 1925, **47**, 442.

The production for 1924 was 10,760 metric tons; exports were 2,348 m.t., a 50% increase over 1923; imports were 1,080 m.t., four times the amount of 1923. In addition to the usual commodities, German rayon is used for garters, gloves, hats, wigs, furs, and flowers. —F.G.P.

Patents

Cuprammonium Cellulose Solution. Cuprammonium Silk: Preparation. Dispersoid Syndicate, Ltd. F.P.578,671 (from *Chem. Zentr.*, 1925, i., 1663).

Water-insoluble copper compounds, such as the carbonate, hydroxide, and copper powder, are dissolved in a colloid mill or other quickly acting dispersion device and cellulose added; to accelerate the dispersion 0·1-1% of aniline, toluidine, urea, or other amino-compound may be added; after filtering the solution can be spun directly to artificial filaments. The ammoniacal solution of the insoluble copper compounds dissolves larger quantities of cellulose than the cuprammonium solution obtained from water-soluble copper salts; the artificial silk so obtained is accordingly worth more. —B.C.I.R.A.

Viscose Preparation. Dispersoid Syndicate, Ltd. F.P.579,048 (from *Chem. Zentr.*, 1925, i., 1664).

Cellulose is mixed with a solution of sodium hydroxide in a colloid mill or similar device, and water is added gradually until a homogeneous solution is obtained. Carbon bisulphide (1 mol. or slightly more) and a hydrocarbon, petroleum, or a non-saponifiable chloro-hydrocarbon are added; to the so formed colloidal dispersion of hydrocarbon and viscose is added 1-3% of ammonia, and if necessary a further quantity of hydrocarbon, and the mixture warmed to 70°-75°. To accelerate coagulation small quantities of salts may be added. After hydro-extraction, the viscose is washed with water, then with weak organic acids, and again with water; the viscose so obtained is dissolved in alkali or ammonia to a concentrated solution and may be spun directly without ageing. —B.C.I.R.A.

Viscose Spinning Bath: Preparation. Erste Böhmische Kunstseidefabrik A.G. F.P. 580,252 (from *Chem. Zentr.*, 1925, i., 1664).

Normal ammonium sulphate solution is added to the sulphuric acid or sodium sulphate spinning bath in quantity depending on the nature of the original cellulose and on the stage of maturity of the viscose, but with a density of at least 1·35. —B.C.I.R.A.

Viscose Solution: Preparation. Naamlooze Vennotschap Nederlandsche Kunstzijdefabrik. F.P.582,548 (from *Chem. Zentr.*, 1925, i., 2424).

The preparation of viscose from cotton waste instead of wood pulp is claimed; the resulting viscose is very pure, and gives a transparent, colourless artificial silk. A mixture of cotton and wood cellulose may also be employed. —B.C.I.R.A.

Mechanical Cotton Picker. A-H. Hanauer. F.P.585,881.

This machine comprises suckers which are applied by the workmen to the bolls, and which extract the hairs from the pods by suction. The hairs are carried away in a box disposed upon an automobile and connected with a sucking pump which draws the hairs over a grid. A system of brushes cleans the cotton. —Bur. Text.

Cellulose Esters: Preparation. R. Müller. D.R.P.400,190 (from *Chem. Zentr.*, 1925, i., 1664).

Cellulose in the flocculent form in which it is obtained in the conveyor-exhaust by the action of the beater on damp raw cellulose is converted into acetyl cellulose or viscose. The conversion of this form of cellulose into acetate or viscose is effected more rapidly than esterification by other methods, and also a product is obtained which is entirely free from small fibres. —B.C.I.R.A.

Wood Pulp Alkali Compressor-Steeper. F. Kempter. D.R.P.406,333 (from *Kunstseide*, 1923, **7**, 20).

A method of impregnating wood cellulose with alkali in viscose manufacture, the process being carried out in closed vessels, partly to exclude air and partly to secure that the free ends of the wood pulp masses are brought under the press. There are at least two pressure vessels in a battery, each is closed by the stamp of the press, and each is fitted with an auxiliary press for compressing the wood chips (if the wood is used in this form), with an inlet valve for the lye, with a press for getting rid of the excess lye, and with an outlet valve for the lye. The vessels are worked so that one is being filled while the process of steeping and pressing is proceeding in the others. —B.C.I.R.A.

Cellulose Ethers: Preparation. G. Teupel. D.R.P.408,342 (from *Chem. Zentr.*, 1925, i., 1665).

In the preparation of cellulose ethers from alkali cellulose and alkyl halide, if a quantity of the salt resulting from the action of the halogen alkyl on the alkali hydroxide during the reaction be added at the beginning to the alkyl cellulose mixture or to the alkali or alkali-cellulose to be employed in the reaction, or to both, the time of etherification is considerably shortened, and the etherification of the cellulose is so complete that a purification of the product by re-dissolving or filtration is unnecessary. —B.C.I.R.A.

Viscose: Preparation. O. Venter. D.R.P. 408,594 (from *Chem. Zentr.*, 1925, i. 1664).

A saving in power is effected by passing cellulose, which has been steeped in caustic alkali in the usual way, through a series of cutting and mixing machines. The alkali

cellulose obtained in this way is specially suitable for treatment with carbon disulphide in artificial silk manufacture.
—B.C.I.R.A.

Artificial Silk Manufacture. Hölkenseide G.m.b.H. D.R.P.410,582 (from *Chem. Zentr.*, 1925, **i.**, 2424).

A method of removing excess spinning solution from the filtered substance consists in drying the substance by the application of heat. The heating is sufficiently strong to cause in addition to drying a chemical decomposition of the adherent spinning solution. Before drying the filtered cake may be subjected to a preliminary pressing to expel excess of spinning solution. The heating and drying are carried out in a closed chamber provided with an arrangement for dilute ammonia recovery. —B.C.I.R.A.

Arsenical Dye Insecticides and Fungicides: Preparation. Farbenfabriken vorm Friedr. Bayer & Co. D.R.P.415,652 (from *Chem. Zentr.*, 1925, **ii.**, 1558).

Dyestuff salts of arsenic and arsenious acids are efficacious protective agents against fungi and bacteria and against insect pests. A solution of Malachite Green arsenate kills parasitic moulds even at great dilution and is also an effective insecticide.
—B.C.I.R.A.

Process for the Manufacture of Glossy and Hollow Artificial Threads. J. E. Branderberger. U.S.P.1,544,631 (from *Text. Colorist*, 1925, **47**, 671).

A solution of viscose having a salt point of not less than 7 is incorporated with a substance capable of forming bubbles. The mixture is then treated to form threads.
—F.G.P.

Process for Making Cellulose Acetate. P. C. Seel. U.S.P.1,544,944 (from *Text. Colorist*, 1925, **47**, 671).

Fibrous cellulose is beaten to a liquid pulp in water, the greater part of the water is extracted, and the mass subjected to picker action and dried. The dried aggregate is treated with acetylating solution. —F.G.P.

Method of Precipitating Artificial Threads, Ribbons, Films, and the Like from Viscose. A. Kampf. U.S.P.1,545,144 (from *Text. Colorist*, 1925, **47**, 671).

The viscose is squirted into an aqueous solution of sulphonic acids of condensation products of phenols with aldehydes, ketones, aldoses, ketoses, and higher molecular hydrocarbons forming these bodies. —F.G.P.

Cellulose: Preparation. Köln-Rottweil A.-G., and E. Opfermann, Berlin, Germany. E.P.241,536.

Cellulose of low viscosity characteristics is obtained without adversely affecting its chemical properties by treatment with small amounts of alkaline substances such as caustic soda, hydroxides of the alkaline earths, magnesium hydroxide, carbonates, bicarbonates, water-glass, and sodium acetate, in combination with the usual oxidising agents, such as hypochlorites and peroxides. In an example, Mitscherlich cellulose is treated with a dilute solution of caustic soda and sodium or calcium hypochlorite. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Production of Artificial Fibres—

241,341. C. Sandoz. Spindle for artificial silk.

241,679. Courtauld's, Ltd., W. H. Glover, and E. v. Weyenbergh. Process for making filaments from cellulose ether-esters.

241,858. R. Garke, E. Meyer, and W. Claasen. Nitrocellulose/india-rubber compound for artificial filaments.

Production of Vegetable Fibres—

241,500. C. W. Russell. Ginning roller.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

New Italian Reeling Machine. *Silk* (N.Y.), 1925, **18**, No. 7, p. 40.

The machine is described as being of great value to newly starting silk growing localities where skilled labour is not readily obtainable. The operator can master the job in four or five days. Although it is useful only for coarse silk, 28/30 den. instead of 9/11, the reeling is said to be uniform; the output is, of course, much higher than with fine silk, and the necessary floor space proportionately less. There is a slight saving in fail. The operator has not to keep her hands in the hot water continually, nor need she remain sitting all day. In the figures showing the saving of 15·4 lire per kilo no account is taken of the difference in value of coarse and fine silk. —F.G.P.

Pima Cotton Gin. J. S. Townsend. *U.S. Dept. of Agriculture Bull.*, No. 1319, 1925, 11 pp.

The varied appearance of baled Pima cotton has been due to the mechanical condition of the cotton caused by the diversity of roller ginning methods in use in Arizona, and not to any lack of uniformity in the cotton itself. The need for uniform methods in the ginning and handling of cotton is emphasised, and an attachment for removing the lint from the gin roller in a way that straightens the fibres and improves the appearance of the cotton is described. The device consists essentially of the replacement of the brush which takes the cotton from the gin

rollers by a rapidly revolving auxiliary wooden roller provided with six flexible flaps projecting about ¾ in. from the surface of the roller. By this method the cotton is taken from the gin roller without being folded or rolled, and falls behind the gin in a smooth, fluffy, and uniform condition.
—B.C.I.R.A.

Cottonising Flax and Hemp. C. F. Greenfield. *Textile Mfr.*, 1925, **51**, 394-395.

A general idea is given of the nature of the processes necessary for the transformation of bast fibres into short, cotton-like fibre. The so-called Dresden process and other processes are discussed. So far as can be learned there are three processes now being worked, one in North Germany under the patents of B. V. Possanner, one in Saxony (Waentig), and one in Wurtemberg (Ulrich Gminder). The raw materials of greatest practical interest are short straw waste straws, seed straw, fibre waste, low grade tow and yarn waste from flax, and the corresponding materials from hemp. One of the greatest difficulties is the removal of woody shives preparatory to treating the fibre. The great potentialities of cottonised fibres are mentioned.
—L.I.R.A.

Flax Scutching, Cheaper: Help for Growers. A. S. Moore. *Text. Rec.*, 1925, **43**, No. 512, p. 85.

States some of the disadvantages of the old method of scutching by hand as compared with the new method of scutching by machinery. A description is given of the flax scutching machine, which was demonstrated recently at the Linen Industry Research Institute by Messrs. Robt. Boby, Ltd., Bury St. Edmunds, England.
—L.I.R.A.

Bacterial Deterioration of Flax Fibre. *Melliand's Textilberichte*, 1925, **6**, 942 (from *Spinner u. Weber*, 1925, No. **49**, 4-10).

Experiments showed that loss in strength in several samples of scutched flax from different retteries was due to bacterial attack. It was found that retting in dirty tanks was liable to endanger the flax, probably by promoting the growth of bacteria which decompose cellulose. Healthy, uniform flax was found to be most resistant to this bacterial attack. The omission of washing after retting was found to lead to a loss in strength of the fibre during the drying process, especially if the tanks used in retting were not clean.
—L.I.R.A.

(B)—Spinning and Doubling

Roller High Draft Mechanism. F. Engelmann. *Leipziger Monats.*, 1924, **39**, 383-386.

The author has independently discovered the "rotary impulse" effect described by Johannsen (see below), and possible means of counteracting it are discussed. A grooved, positively driven middle roller, similar to that of Johannsen, is adopted, and in addition the advantages of breaking the plane of the drawing field, so that the middle rollers are slightly above the front and back rollers are emphasised. Attention is also drawn to the advantages of a four-roller mechanism in which a pair of small rollers is interposed between the front and middle rollers; as in the three roller systems, the plane of the drawing field is preferably broken. Suitable roller weights, diameters, and distances apart of the rollers are discussed, and the disposition of cleaning rollers in the drafting area is described.
—B.C.I.R.A.

Jannink High Draft Mechanism: Faults; and Grooved Rollers High Draft Mechanism. O. Johannsen. *Leipziger Monats.*, Supplement, July 1924, 30 pp.

Theoretical relationships of the Jannink high draft system are established and discussed with reference to Sea Island and American cottons. The chief source of error in this system is the "rotary impulse" of the light middle top roller with respect to its bottom roller (due to the rapid passage of the cotton between the rollers), and exposure of the different layers of roving to varying speeds and friction relationships. It is shown that by reducing the roller setting from 23 to 18 mm. the number of positively led fibres is very considerably increased, so that the number of floating fibres is reduced, and more even drafting would be obtained if the rotary impulse factor did not intervene. The magnitude of the rotary impulse is calculated; the effect varies inversely as the distance apart of the rollers and directly with the weight of the top middle roller. The weight of this roller is an extremely important factor, and experiments show that there is always an optimum roller weight for the production of the best yarn. The calculation of the most suitable weight of roller to reduce the rotary impulse effect to a minimum is shown. The roving number and the draft are especially important factors in the choice of roller weight. In the second section of the paper extensive experimental data relating to the Jannink system are recorded, and it is shown that these support the theoretical deductions of the first section. It is pointed out that the rotary impulse effect varies for different raw materials, and the relations deduced apply only to the Sea Island and American cottons for which they were established. Yarn spun on the Jannink system has a rougher appearance than ordinarily spun yarn, and the amount of fly is greater. Experiments on the amount of fly per spindle per hour show that the amount is reduced as the rollers are brought close together; simultaneously the roughness of the yarn is reduced. Photo-micrographs are reproduced showing the position of the

fibres in the main drafting area for different drafts and for roller settings of 18 and 23 mms. The advantage of the 18 over the 23 mm. setting is clearly indicated. In the third section of the paper means for overcoming the rotary impulse effect are described. They comprise the replacement of the smooth middle rollers by rollers laterally grooved at both ends for a distance of about 6 mms. The "teeth" formed by the grooves should have a triangular cross-section, and those of the upper and lower rollers intermesh, providing a positive drive for the upper roller, and preventing its lifting by the cotton passing through. It is claimed that a stronger and more even yarn is obtained than when smooth rollers are used, and there is no fly and less fibre breakage. The device is protected by G.P. 372,823. A proposal is made to include two cleaning rollers below, and one above the grooved rollers, to prevent the winding on of fibres. Experiments show that the top roller may be lighter in weight with grooved rollers.
—B.C.I.R.A.

Silk Throwing. *Silk Jl.*, 1925, **2**, No. 15, p. 35.

Explanations of some terms in use among throwsters are given. The methods of determining the denier of silk vary considerably. The French denier is the weight in half decigrammes of a skein of 450 metres; the Manchester count is the weight in drams of 1,000 yards; the Yorkshire count is the number of yards per ounce; the English count is the number of hanks of 840 yards to the pound; the Italian count is said to be the number of hanks of 400 French ells, equalling 476 metres, or 520 English yards, which weigh 1 oz. avoir., divided into $533\frac{1}{3}$ denier (to the ounce). No explanation is given as to why the Italians adopt the English ounce. This method is also used by the London Silk Conditioning House. —F.G.P.

Spinning Frame Automatic Cleaning Fan. Firth-Smith Co. *Text. World*, 1925, **68**, 2499.

A device to prevent the collection of fly on machinery is described. It is arranged in separate units, each unit consisting of a travelling electric fan which runs continuously over the machines on an endless monorail suspended from the ceiling. Each machine is automatically visited at regular intervals, and the fan guides the particles of lint past the machinery to the floor. Each unit will serve 12 to 24 fly spinning or doubling frames. When the cleaner reaches the belt ends of the frames it automatically swivels and passes the belts edgewise, then springs back into position to pass over the next frame. Two models are made. In one the air from the outlet is directed downwards, and is for use over machinery. The second model directs the air at an angle, and is intended for machinery open only at the sides.
—B.C.I.R.A.

Worsted Spinning Frames. Texus. *Wool Record*, 1925, **28**, 732.

A comparison of the methods of tensioning and winding-on of the three types of continuous spinning frames—cap, flyer, and ring—which shows that in the flyer frame the method of winding-on varies only the speed of the bobbin without disturbing the twist uniformity. In the cap and ring systems the twist in the yarn varies slightly, according to the diameter of the bobbin at the point of winding-on. In view of the increasing use of ring rovers in worsted spinning, this twist effect is important and needs consideration, as the softest roving will be nearest the bobbin barrel, and the hardest on the outside layer of the bobbin. —B.R.A.W. & W.I.

(D)—Yarns and Cords

The Lustre of Raw Cottons and of Folded Yarns Spun from them. A. Adderley. *J. Text. Inst.*, 1925, **16**, T.352-358.

Patents

Mechanism for Drawing. Filatures et tissages Haussmann. F.P.585,952.

The pair of middle rollers is raised higher than the pair of drawing rollers and nearer to them. In the free space between the two pairs of rollers is put an additional roller determining with one of the middle rollers the origin of the drawing and leaning sidewise upon this middle roller. This disposal permits diminution in the length of the drawing, and suppresses prejudicial pressure on the fibre at the point where the drawing begins. —Bur. Text.

Leaves Rasping Machine. J. Baldinger. F.P.586,080.

The leaves are strongly pressed by the ends of their roots by a disc. They are stripped off by a beating drum. They are then turned upside down by a returning pulley, and submitted to the action of a little drum which tears the roots. —Bur. Text.

Yarn Doubling or Covering Machine. J. M. Collinge, Royton, Lancashire, and Climax Machine Co. Ltd., Stalybridge, Cheshire. E.P.241,275.

In a machine for twisting or for doubling yarn, or for covering yarn, thread, &c., with, for example, artificial silk, the flyer and delivery bobbin are mounted independently of each other, so that the bobbin may be mounted on a hinged support adapted to be turned down for doffing, piecing, or other operation, and the material is looped round a roller and is wound on a carrier such as that described in Specification 171,215. The hinged support is held in operative position by an adjustable pivoted arm. The bobbin is carried on a hollow spindle through which the core yarn passes when covering. —B.C.I.R.A.

Winding Machine Stop Motion. J. O. McKean, Westfield, Mass., U.S.A. E.P. 241,351.

The housing of each head of a machine for winding yarns and the like is mounted on a pivot on the base, around which it is moved by a spring upon breakage or exhaustion of the yarn, so as to slacken the driving belt, a lever being provided to lock it in its non-winding position. The pressure of the guide against the cop, and the tension of the yarn, are gradually decreased in accordance with the growth of the cop, and a catch lever is provided to steady the outward movement of the guide mechanism and to prevent unintentional inward movement during the winding of the cop. —B.C.I.R.A.

Spinning Spindle Driving Apparatus. J. J. Keyser, Aarau, Switzerland. E.P. 241,485.

The supporting frames for shafts by which the spindles are driven are formed with abutting flanges which receive securing bolts, and serve as a housing for the bearing. The inner member of the bearing is formed with flat-sided studs which enter slots in the shaft section, and are locked therein by sleeves on which are mounted the frictionally-driven worm wheels which drive the spindles. In a modification the abutting flanges are recessed so as to enclose partially the bearing. —B.C.I.R.A.

Draw Frame Sliver Conductor. G. Green, and J. E. Mitchell, Rochdale, Lancs. E.P.241,663.

The sliver conductor over which the slivers pass from the cans to the drawing rollers of a drawing frame is provided with an undulating surface forming grooves in which the individual slivers are guided. The grooves are formed to converge towards a common centre. —B.C.I.R.A.

Winding Machine Thread Guide. E. Appleby, Aston, Birmingham. E.P.241,709.

T-shaped guides for winding machines comprise a screwed stem and a round bar or roller mounted between the upturned ends of a metal head secured to the stem, the ends being adapted to prevent the threads from fouling the ends of the roller. The front and back edges of the ends may be flared. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Spinning and Doubling—

241,369. G. Spencer Moulton & Co. Ltd., and D. M. Proctor. Trap roller covers.

241,477. T. Wright. Retaining thimble for drag washer.

241,686. W. & M. Gaskell. Horsehair yarn doubler.

Subsequent Processes—

241,833. W. S. Thompson. Yarn dressing machine cylinder.

241,922. A. Fassini. Drying machine for artificial filaments.

Yarns and Cords—

241,239. L. Lupke. Braiding machine.

241,875. E. Krenzler. Braiding machine.

3—CONVERSION OF YARNS INTO FABRICS

(B)—Sizing

Sized Warps: Moisture Content. Textile Operating Executives of Georgia. *Cotton*, 1925, **89**, 1233.

The question whether warps should come from the slasher entirely dry or slightly moist is discussed. One speaker stated that warps coming from two slashers equipped with Power's temperature controls were cool, and contained about 6% of moisture. It was agreed that sized warps should be in a moist condition, and that this could be judged by their temperature as they came from the slasher. They should feel cool, and the machine should be run to give this effect. —B.C.I.R.A.

Artificial Silk Slashing Machine. Saco-Lowell Shops. *Text. World*, 1925, **68**, 2499.

A slashing machine for sizing artificial silk based on the ordinary type of cotton slasher has been developed. Among other changes the size vat has been moved nearer the drying cylinder, and a guiding roller has been placed close to the cylinder in order that the yarn may strike the drying cylinder sooner than in the cotton slasher. A single roller vat is used. The distance between the carrying and measuring rollers has been shortened to one-fifth of its usual length, and delivery rollers are replaced by the single carrying roller over which the yarn passes. —B.C.I.R.A.

Size: Boiling. Textile Operating Executives of Georgia. *Cotton*, 1925, **89**, 1232-1233.

In a discussion on the best method of cooking size it is stated that a great deal depends upon how quickly the batch is brought to boiling point. By allowing the size to come to the boil gradually in a pre-determined time instead of as rapidly as possible the quantity of thin boiling starch in a batch can be cut down whilst giving equally good results, and equal results can be obtained with thick boiling as with thin boiling starch with less expense in total sizing cost. —B.C.I.R.A.

Sizing of Textile Fibres. I. Ginsberg. *Textile Colorist*, 1926, **48**, 28-32.

A general discussion on the use of starches, dextrin, and mineral substances employed

in sizing yarns and fabrics. Reference is made to the solubilising action of activin (sodium *p*-toluenesulphochloramide) on starch, and the effect of prolonged boiling on the viscosity of starch pastes and filling mixtures. —A.J.H.

(C)—Weaving

Looms; Electromagnetic Driving of——. *L'Avenir Text.*, 1925, **7**, 589-595.

The drive for the warp beam is by an electromagnetically reciprocated double plunger, the two parts being joined by an adjustable sleeve. Each end of the double plunger carries a pawl, which engages with a ratchet wheel, each ratchet being furnished with a catch which engages with it at the required intervals. The drive for the beating-up motion depends on electromagnets with telescopic cores, and the tightening of the warp threads can be adjusted without dismantling. The dobby motion is effected by a series of electromagnets, contacts for which are made in a glycerine-oil mixture which prevents sparking. The pick motion is effected by a soft iron core mounted on ball bearings, being subjected alternately to the magnetic field of two solenoids, of which one causes it to impact the shuttle and the other returns it to its initial position. Modifications of this motion are described for looms using more than one shuttle. The appliance for regulating the current to the different parts of the loom are described. It is driven by a low power electrical motor. A multiplication of the contacts on this shaft will allow it to control a series of looms at the same speed. The contacts can be immersed in oil.
—L.I.R.A.

Artificial Silk Weaving. *Kunstseide*, 1925, **7**, 223-226.

The article relates to weaving artificial silk, and describes numerous applications of "Atlas" artificial silk to produce highly lustrous fabrics in which the Atlas silk may be used alone or woven with other fibres. A sample is provided of a fancy weave in which the warp and weft are both of artificial Atlas silk of 200 denier, the warp being twisted. —B.C.I.R.A.

Loom Harness: Selection. Textile Operating Executives of Georgia. *Cotton*, 1925, **89**, 1228-1230.

An inconclusive discussion on the comparative values of steel harness and cotton harness in weaving denims, twills, and sheetings. The general opinion appears to be that cotton harness quickly wears through, though it is suggested that it keeps its position better than steel harness.
—B.C.I.R.A.

"Wavy" Twills; Causes of——. Textile Operating Executives of Georgia. *Cotton*, 1925, **89**, 1230.

In the weaving of regular three-harness drills or four-harness twills a wavy effect on the angle of the twill is frequently due to irregular harness and insufficient friction in the shuttle to draw the weft properly.
—B.C.I.R.A.

Picker Stick: Design. Textile Operating Executives of Georgia. *Cotton*, 1925, **89**, 1231.

In a discussion on the design of the cushion for picker sticks it is stated that the Eagle and Phœnix Mills are well satisfied with a cushion of the following type—The picker stick is hollowed out and a rubber cushion glued down. The leather head is then put on. In picker sticks which have been running a year the rubber cushion is still in good condition. —B.C.I.R.A.

No More Shires or Tight Picks. *Amer. Silk Jl.*, 1925, **44**, No. 8, p. 68.

A free gauge is attached to the breast beam by two screws, and works automatically with the stopper handle. Stopping the loom throws the gauge out of action, and restarting brings it in again. It enables the weaver to gauge the amount of let-back with no loss of time in working the take-up mechanism. The gauge is adjustable all ways for wide or narrow weaves, and cannot get out of order; it is said that it saves its cost on the first piece woven, and that a four-months' learner, with the device, produces better goods than a year's worker without it. —F.G.P.

Loom Troubles and How to Fix Them. *Amer. Silk Jl.*, 1925, **44**, No. 7, p. 55.

The form, balance, and weight of the shuttle should be studied with a view to removing loom troubles. A good shuttle, when balanced between the tips of the forefingers, will turn face down; it should stand on back, face, and sides absolutely level, and the back should be exactly at right angles to the sides. A heavy shuttle holds its course with better alignment than a light one. When two or more shuttles are used it is essential that they be of uniform size, shape, and weight. The force of the pick should be only just enough to drive the shuttle from one box to the other, otherwise it may cause a rebound, giving rise to cockled shoot, or the loom may bang off, and in extreme cases there may be damage to the machine. The picker should always be designed for the loom, and not be taken from a collection of oddments. Warped or worn pickers are troublesome to the free riding of the motion. The bottom of the box must be on the same level as the race; all the surface of the binder in the front of the box should meet the shuttle as it comes in. Closer attention to shuttle travels will result in greater production, better quality, and more satisfied operators. —F.G.P.

Weft Changing Mechanism. Polet and Laforet. *Rev. Textile*, 1924, **22**, 469-475.

A new system of automatically changing the shuttle of a loom by which it is aimed

at increasing the time allowed for the cop changing operation. The system of vertical changing is characterised by the fact that the changing gear, which is operated in the normal way by the weft-fork operating a connecting rod, causes (*a*) the transference by a horizontal carrier of the full cop from the magazine to a position at the entrance to the race and above the shuttle box; (*b*) the vertical feed of the full cop, thus brought into position, by a vertical feed constructed in one piece with the race; (*c*) the operation of the horizontal carrier by the gears driven by oscillations of the connecting rod; and (*d*) the operation of the vertical feed by auxiliary cams on the crankshaft of the loom or on the tappet shaft operated by gears controlled by the oscillations of the connecting rod.
—B.C.I.R.A.

Reed and Heald Polishing Machine. S. Vollenweider Co. *Melliand's Textilberichte*, 1925, **6**, 659-660.

Experience shows that warps are less roughened and torn by a highly polished reed than by ordinarily treated reeds, and a special polishing machine is described. The procedure has proved so successful that healds are now subjected to the same treatment. The machines are essentially the same for both purposes, and comprise two rapidly rotating circular brushes between which the reeds or healds are held, the brushes simultaneously moving up and down and laterally The fundamental difference between the machines is in the driving and control of the brushes. —B.C.I.R.A.

Chemistry of Adhesives. See Section 6.

(D)—Knitting

Ribbed Borders: Knitting. Les Fils de Valton et Cie. *Rev. Textile*, 1924, **22**, 501-503.

Two novel forms of ribbed borders for knitting on to articles such as stockings, sleeves, &c., are described. Instead of being knitted in bands in the usual way the borders are made in strips, each border length being provided with a strip of plain knitting on either side which can be easily unravelled when joining the border to the article. —B.C.I.R.A.

"Maxim" Knitting Machine. *Rev. Textile*, 1924, **22**, 191-201, 293-301, and 403-407.

A detailed description of the "Maxim" knitting machine for making seamless stockings and other articles. The machine embodies all recent improvements for varying the knitting length; it is provided with several thread guides for automatically changing the thread, allowing for the use of yarns of different strengths for foot and leg; and tapering the width at the ankle is accomplished without difficulty. The "Maxim" possesses the advantages of having no revolving bobbins, which allows of one worker looking after 8 or 10 machines, and the accessibility of all the parts is such that much time is saved. The moving parts of the machine and the method of working are described in detail with the aid of diagrams. —B.C.I.R.A.

Uses of Lace Stitch in Knitting. W. Davis. *Silk Jl.*, 1925, **2**, No. 15, p. 39.

Openwork effects are largely used in underwear, and more so in the tie trade. The knitted tie is usually broad at the end and then narrowed with the lace effect for some distance; this is followed by a strip of plain to go round the collar, when the lace work is again commenced as before. Descriptions are given of a variety of lace designs for production of heavy rich effects.
—F.G.P.

Tuck and Shell Knitted Fabrics. W. Davis. *Text. American*, 1925, **43**, No. 4, p. 38.

Description of the method of knitting a number of fabrics in such a way that the monotony of cross stripes may be broken up, producing more acceptable patterns. By varying the tension of certain threads a blurred irregular effect is produced which adds to the pleasing effect. —F.G.P.

Mercerised Yarns in Hosiery Goods. *Dyer and Cal. Printer*, 1926, **55**, 57.

Increased importance is attached to the use of mercerised cotton yarns in mixture with cellulose artificial silks, since the elastic and hygroscopic properties of mercerised yarns approach more closely than non-mercerised yarns to those of artificial silks. Mercerised cotton yarns are particularly suitable for use as carriers for artificial silk yarns in hosiery, much waste being thereby avoided in the knitting processes. —A.J.H.

(G)—Fabrics

The Cult of Metal Cloths. D. Hemming. *Silk Jl.*, 1925, **2**, No. 15, p. 53.

Since the introduction of metal cloths from Italy at the time of the Renaissance, French weavers have been noted for the fabrics. Formerly it was very costly, and used only at Courts and by high church dignitaries; now Lyons produces lamé that is of moderate price, is soft as foulard, and does not crease. Wonderful fabrics in coral and silver with Chinese designs are described, woven in such width that dresses may be made with a single seam. Lamé crepe has the metal thread twisted as well as the silk. Combinations of lamé with embroidery and with prints are still very popular. In some cases rayon is being used to replace the metal thread.
—F.G.P.

Fabrics of the Day: Flanelle de Soie. J. Chittick. *Silk* (N.Y.), 1925, **18**, No. 7, p. 39.

Silk flannel is imported to America from France. It has a dull, lustreless appearance, and a soft, glove-like feel. The

bold, contrasted stripes are dyed in the warp yarn; it is distinctly a sports fabric. Spun silk is used in the manufacture. The analysis given is—Warp, 112 ends of 60/2 yarn; weft, 80 picks of 60/1. The warp yarn has 15 twists. There is a long description of the origin and manufacture of spun silk. —F.G.P.

Tulle Weaving. M. Böhmer. *Melliand's Textilberichte*, 1925, **6**, 645-647.

A further mathematical treatment of conditions in the weaving of tulle of various qualities and meshes. —B.C.I.R.A.

Shirting Fabrics for the Indian Market. H. R. Band. *Dyer and Cal. Printer*, 1926, **55**, 30-31.

Competition between English and Indian finishers, particularly in the production of pure clothes, is keen, because Indian mills are now equipped with the best finishing machinery. Finished and stiffened fabrics exported from England become much more mellow during transport to India, and it is therefore advisable to give such fabrics a firmer initial finish. Bombay merchants test the looseness of fillings in imported stiffened fabrics. Glycerine is the safest deliquescent substance for use in filled goods for India; calcium or magnesium chloride and glucose are more favourable to the development of mildew. Fabrics filled with substances containing animal fats are likely to offend the religious feelings of Hindus. A demand exists for low quality Indian shirtings filled with starch and China clay; a suitable filling mixture for such fabrics is described. —A.J.H.

PATENTS

Electric Warp Stop Motion. E. Giro-Prat. F.P.585,530.

The inferior plate of contact is in relation with a pole of the electric circuit, and forms an inclined plane, so that when the yarn breaks the dropper falls and slides on the inclined plane, thus ensuring a certain and durable contact. —Bur. Text.

Colloidal Shellac Sizing Solution: Application. J. P. T. A. Legrand (from *Chem. Zentr.*, 1925, **ii.**, 2327). F.P.585,547.

Fibrous material is sized with a colloidal solution of shellac in dilute caustic soda. —B.C.I.R.A.

Knitting Machine for "Guilloché" Articles. Société générale de bonneterie. F.P. 586,515.

This machine permits to produce "Guilloché" or "Richelieu" articles on a rectilinear knitting machine of the cotton type. It consists of a needle bar with a range of fixed short needles, several ranges of long needles vertically displaceable as to the bar, either together or separately, and a movable griffe mounted so that it can slide and oscillate on a shaft. —Bur. Text.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Weaving—

241,395. A. L. Blackburn. Weft bobbin.

241,685. L. Wind. Separately-adjustable double reed.

Knitting—

241,318. G. Stibbe. Circular knitting machine with single-cam needle beds.

241,392. Wolsey, Ltd., E. T. Walker, and A. Tyler. Slack-top knitting device for stockings.

241,438. E. L. Cummings. Double-faced pile fabric device.

Fabrics—

241,557. G. Austerweil, P. D. Aron, and E. Martin. Aeroplane wing fabrics.

241,570. Duratex Corporation. Pile fabric construction.

4—CHEMICAL AND OTHER PROCESSES

(B)—SCOURING AND DEGUMMING

The Real Loss in Boil-off. A. Rosenzweig. *Amer. Silk Jl.*, 1925, **44**, No. 8, p. 55.

The author states that the Lyons and Milan figures for amount of gum in silk are inaccurate, but his own are correct. From his figures all weighted silk was excluded; the most efficient test for weighting is to smell the sample; sight and handling confirm this. His averages were calculated from weights at a temperature of 105°-110° C. on a balance of one-two hundred millionth sensibility, increased by 1/9th, and rounded off to ½%. China silk has a boil-off of 17%, Japan 17½%, Prussia (? Broussa) 19½%, Italian (pure yellow) 23%, Syria 23½%. —F.G.P.

Recovery of Wool Fat. J. de Raeve. *J. Ind. and Eng. Chem.*, 1925, **17**, 837.

The method described depends on treatment with chlorine at the lowest possible temperature, which oxidises the proteins without deteriorating the fats. The effluent is first purified by treatment with freshly slaked lime at 70°-80° C. under gentle agitation by a steam blower. The liquor is then filtered, left to cool to 29° C., and pumped into another vat. On leaving the pump it is met with a regulated quantity of chlorine gas. A thick, greasy foam rises to the surface, and is treated with sufficient dilute sulphuric acid to convert the hypochlorites into hypocholorous acid. After further agitation more fat rises to the surface, and is added to the main quantity. The fat thus obtained does not deteriorate owing to the presence of traces of chlorine. —B.R.A.W. & W.I.

Treatments for Half Silk. *Text. Colorist*, 1925, **47**, 452.

Silk-cotton mixtures are singed through the open flame machine. Degumming is

done in a bath of fatty soap. If white goods are wanted, white soap is used; for coloured goods green olive oil soap. For cheaper goods olive oil and soft soap are used. Hard water is not recommended. It is said the monopol soap is beneficial if the water is not sufficiently soft.

—F.G.P.

Removal of Soaps from Wool. See Section 4K.

(C)—Washing

W.K.T. Artificial Silk Washing Machine. P. Krais. *Kunstseide*, 1925, **7**, 236-238.

The machine is designed to perform the processes of complete washing, twisting, and hanking artificial silk filaments direct from the spinning machine in one operation. The advantages of the machine are a shortened time of washing, a strengthening of the filament by twisting at an early stage, and the possibility of detecting spinning irregularities with a short period. The construction of the machine is shown by a diagram, and tests carried out with it at the Dresden Forschungsinstitut are described. The results compare favourably with those obtained by washing and winding in the usual way. —B.C.I.R.A.

(E)—Drying and Conditioning

Improvements in Conditioning of Textile Fibres. J. Obermiller. *Melliand's Textilberichte*, 1925, **16**, 764.

As a result of experiments with cotton, wool, and silk, and artificial silk, the writer suggests a drying temperature of 95°-100° for vegetable and wool fibres. This temperature would probably suffice for silk and art silk, and could be maintained by a boiling water bath or by means of steam coils. During drying, warmed air of about 50%-55% moisture content should be forced through the material, thus preventing stagnation of the moist air within the fibres. A 200 m. temperature of 15-25 is recommended, and any gases of combustion should be carefully excluded.

—B.R.A.W. & W.I.

Castor Oil: Composition and Properties. A. Eibner and E. Munzing. *Chem. Abstr.*, 1925, **19**, p. 3027 (from *Chem. Umschau*, 1925, **32**, 166.

The first part deals with the hardening of drying oils. The second gives a quantitative analysis of castor oil, which consists of 80% ricinoleic acid, 9% oleic acid, 3% linolic acid, and dihydroxystearic and stearic acids 3%. Behaviour on reduction and oxidation given. —B.L.R.A.

Climatic Conditions and the Worsted Industries. "Technologist." *Text. Rec.*, 1925, **43**, No. 512, pp. 61-62.

The writer reviews the subject of moisture relations of wool. The importance of water content in manufacturing processes and in consequent effect on the finished product is emphasised. The difficulties of standardisation and of making proper allowance during manufacturing processes for this continually changing factor are discussed. A standard regain of 17% instead of 18¼% is recommended. The work of the Conditioning House at Bradford is described. The defects which may result from the fine water spray method of moistening are pointed out. The advantage under present day conditions obtained by spinners who deliver unconditioned yarn is mentioned.

—L.I.R.A.

(G)—Bleaching

Artificial Silk Waste: Bleaching. W. Kosche. *Amer. Dyestuff Reporter*, 1925, **14**, 650-652 (from *Faerber Zeit.*, 1925, 167.)

Artificial silk waste may be divided into four classes—waste obtained from the manufacturers of the product, viscose waste, material obtained from the spinning and weaving processes, and sweepings collected in spinning and weaving mills, and the silk which has been used for polishing purposes. In general, the waste is pulled apart to allow all mechanical impurities to escape, is bleached and dried. A single direct bleach with sodium hypochlorite is never satisfactory, and a preliminary process is applied shortly before the material is packed in the kier. The procedure for each of the four classes of waste is briefly described. —B.C.I.R.A.

Bleaching Problems. H. Wenzl. *Chem. Abstr.*, 1925, **19**, 3017 (from *Wochl. Papierfabr.*, 1925, **56**, S.N. 57-62.)

A review of recent developments in the bleaching of wood pulp. The chemical works of Griesheim-Elektron has recently introduced a caustic soda bleach (25° Bé) containing 150-160 g. per litre active chlorine and also crystalline calcium oxychloride, "Perchloron," which is completely soluble in water. —L.I.R.A.

Cold Bleaching. R. Mohr. *Melliand's Textilberichte*, 1925, **6**, 909-912.

The author describes in some detail his system of cold-bleaching for cotton goods. The material after singeing, destarching, and washing is heated successively in the same vessel with liquors containing (*a*) chlorine, (*b*) acid, and (*c*) peroxide. These operations are conducted under a pressure of three atmospheres, and the liquor is circulated by means of a pump. The goods are then removed from the bleaching vessel and thoroughly washed. The special plant required for the process is briefly described. A considerable reduction of the usual loss in weight in bleaching is made possible by this process, and goods with dyed effects and artificial silk effects and goods for printing may be successfully

bleached. In the near future thirteen installations for conducting the Mohr bleach will be in operation. —L.I.R.A.

Bleaching, Especially with Regard to Bleaching with Electrolytic Bleach Liquor. W. A. Foulon. *Chem. Zentr.*, 1925, **2**, 1390 (from *Zeit. f. Ges. Textilind.*, **28**, 361-364).

The effect of temperature, acidity, and concentration of the bleach bath upon the material is discussed. —L.I.R.A.

Solvent Extraction of Cotton and Linen as an Adjunct to Kier Boiling and Bleaching of These Fabrics. W. Kirk. *Chem. Abstr.*, 1925, **19**, 3023 (from *Text. Colorist*, 1925, **47**, 427-430).

The use of the chlorinated solvents, including *graphikleen*, which is a mixture of tetrachloroethane and a soluble oil, such as Turkey red oil, is described.

—L.I.R.A.

Alcoholic Sodium Hydrosulphite Solution: Reducing Power. J. Pokorny. *Rev. gén. Mat. Col.*, 1925, **29**, 288.

The use of an aqueous alcoholic solution of sodium hydrosulphite for bleaching tussah silk is described. The result is much superior to that obtained with the same quantity of hydrosulphite in aqueous solution, and the alcoholic solution of hydrosulphite is more stable.

—B.C.I.R.A.

Cotton-Artificial Silk Union Fabrics: Bleaching. R. W. Arrington. *Amer. Dyestuff Reporter*, 1925, **14**, 726-728.

A general lecture on the bleaching and finishing of cotton fabrics containing artificial silk. —B.C.I.R.A.

Improvements in Bleaching Processes. J. R. MacMillan. *Chemicals*, Dyestuff Number, 1925, **24**, 34.

The author claims to obtain improved results in bleaching various vegetable fibres by the simultaneous use of bleaching powder and chlorine in dilute solution. (U.S. Patent 1,547,138.) —L.I.R.A.

Cellulose Constitution in Mercerised Cotton. See Section Ic.

(H)—Mercerising

Cotton Fabric: Mercerisation. P. P. Budnikoff. *Melliand's Textilberichte*, 1925, **6**, 661-662.

Mercerisation with nitric acid improves the general properties of cotton fabrics and yarns, and considerably increases their affinity for dyes. The following is a summary of results obtained in an investigation. The cotton shrinks to the extent of 10%, and is some 20% stronger. The optimum temperature is 15°-28° C., and the optimum concentration of acid 40°-41° Bé. The duration of reaction varies between 30 seconds and 21 hours, according to the dye to be applied. After several minutes' treatment at the given concentration cotton gives deeper shades than in ordinary dyeing. The affinity of the fibre for some dyes increases progressively to a definite limit, which depends on the duration of the treatment, and then begins to fall progressively. The treated material must be carefully rinsed with water, a dilute solution of caustic soda, or a solution of sodium sulphide. The maximum depth of colour is reached after about three hours' treatment; further treatment lessens the affinity and tenders the fibre. Tendering is prevented by lowering the temperature, but the affinity is also lessened. The fastness to light and soap of dyed materials is increased by preliminary mercerisation with nitric acid. —B.C.I.R.A.

(I)—Dyeing

Certain Mechanical Methods Used in Dyeing Silk Yarns. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 7, p. 43.

The dyed and washed yarn is taken from the centrifuger and dried in cots, where hot air circulates. Where the heat is under quick control the temperature may be fairly high just at first, but as dyeing proceeds it should be lowered to 95° F., or the lustre may suffer. All surfaces likely to be touched by silk should be perfectly smooth. —F.G.P.

Dyeing Silk to a Match. W. R. McKennon. *Text. Colorist*, 1925, **47**, 238.

Some notes for the apprentice making his first appearance in the dye-house, advising him not to try to match wet against a dry sample; if it is too dark in one place to go to a lighter; not to try to match when the eyes are fatigued, &c. —F.G.P.

Rotary Skein Dyeing Machines. *Text. Colorist*, 1925, **47**, 308.

The machine described is for silk, and may be used for rayon or mercerised cotton. The tank is constructed of insulated copper or monel metal, and the run-off pipe is so situated that the liquor is completely drawn off. The reel which holds the sticks on which the skeins hang is driven b[illegible] bronze pinion; it is of large diameter, and there is no great strain in driving; variable gear is provided. The leakage of lubricant is avoided by felt washers and by caps. The reel is hoisted out of the liquor by means of a counterweight. The sticks, which are made of Port Oxford cedar, the most expensive but most suitable wood for the purpose, are caused to rotate by a star wheel at each end. —F.G.P.

Modern Equipment: Coils. *Text. Colorist.*, 1925, **47**, 443.

The use of open or closed coils is discussed. The latter require more steam to produce the required temperature; the former causes dilution of the dye or other baths. The cessation of vibration when open coils

are used is commonly taken as the indication of incipient ebullition. In dyeing silk in acid dye baths the temperature must be below boiling to avoid tangling of the fibres. For this reason open coils should not be used. To equalise the temperature, either the water or the goods should be moved about. In some baths coils are placed at the sides as well as at the bottom. —F.G.P.

A Dye Beck for Silk Piece Goods. *Text. Colorist*, 1925, **47**, 446.

The bath has a separate compartment for addition of dyestuff and the steam pipe. The goods are sewn together in rope form in a continuous circle, which is moved over an oval dye reel; this, when dyeing is complete, lays the material in folds on a platform, thus simplifying handling and preventing tangles. —F.G.P.

Some Points as to Dyeing Silk. *Text. Colorist*, 1925, **47**, 447.

The dyer is advised to select suitable dyes to produce the desired shade. Broken boil-off liquor is recommended for dyeing. In some American dyehouses boil-off liquor is wasted, and goods are dyed without it. It is stated that often they require to get the colour on the silk evenly, so that the shade will be "level." In these cases boil-off liquor is recommended. In breaking the liquor they taste it until it is sufficiently acid, or sometimes use a blue litmus paper, which is stated to give a red colouration when sufficient acid has been added. If Alkali Blue is used the bath is to be alkaline, hence the name, less boil-off liquor used, and the goods afterwards washed in a bath strongly acidified with acetic acid. Tussah silk requires no boil-off liquor in the dyebath. The degumming liquid from Tussah is not saved on account of the impurities. —F.G.P.

Clays: Dye Adsorption. H. R. Thies. *J. Ind. and Eng. Chem.*, 1925, **17**, 1165-1169.

In studying the differences in rubber-curing properties of various clays the authors found that the method of measuring the amount of dye adsorbed by the different clays in the standard way described was a practicable method of judging of their curing properties. Good curing clays showed low dye adsorption (therefore probably low adsorption of organic accelerators). Tables of dye adsorption tests are given, and erratic dye adsorption values of certain good clays are ascribed to the effect of hydrogen-ion concentration. —B.C.I.R.A.

Cotton Yarn Skeins: Dyeing. L. J. Matos. *Amer. Dyestuff Reporter*, 1925, **14**, 667 (from *Dyestuffs*).

A general outline of the practice of dyeing cotton yarn in skein form with direct and with basic colours. It is stated that unevenness in shade is likely to occur if batches of yarn between operations are allowed to lie in heaps in the dyehouse whilst in a wet condition. —B.C.I.R.A.

Dyeing: Dyes Fast Against Bleaching. W. R. McKennon. *Chem. Abstr.*, 1925, **19**, 2748 (from *Text. Colorist*, 1925, **47**, 383).

A list of dyes is given. —L.I.R.A.

Immunised Cotton: Dyeing Properties. G. Tagliani. *Chem. Abstr.*, 1925, **19**, 2749 (from *Textile World*, 1925, **67**, 3547).

A discussion of the properties, particularly as to dyeing, of the various cellulose esters. Cellulose treated with *p*-toluene sulphonyl chlorides, marketed as "immunised cotton," resists the direct dyes, but it is dyed by the basic, certain acid, and gallocyanine dyes. It absorbs diazotisable amino bases from solution, and in some respects resembles acetate silk in its dyeing properties. It can therefore be used for the coloured-thread effects in cotton, wool, and union materials. —B.L.R.A.

Artificial Silk: Dyeing. *Kunstseide*, 1925, **7**, 231-233.

Directions for dyeing the various types of artificial silk, including acetate silk, which requires a preliminary saponification treatment. Where delicate shades are required and a preliminary bleaching is necessary, instructions for carrying out the bleaching are given. The process of brightening or clearing the colour of the dyed article by treatment with an oil-soda emulsion is described. —B.C.I.R.A.

Indigo Dyed Fabric: Nitrate Discharge. M. Freiberger. *Cellulosechemie*, 1925, **6**, 134 (from *Z. ges. Textilind.*, 1925, **28**, 178, 193).

A note on the action of concentrated sulphuric and nitric acids on cellulose by the nitrate discharge method on indigo. The discharged parts of a cellulose subjected to the nitrate discharge method consist only of swollen cellulose if the discharge is carried out in a faulty machine which does not sufficiently squeeze the material. Thus the discharged parts show either mercerisation or oxy- or hydro-cellulose formation. The nitrate discharge method was the forerunner of the modern technical processes for improving cotton which rest on mechanical changes, i.e., swelling of the cellulose with strong acids. Philanising, i.e., treatment with nitric acid, changes cotton so that it assumes either a woollen- or linen-like appearance. —B.C.I.R.A.

Sulphur Dyes: Application. W. Kosche. *Melliand's Textilberichte*, 1925, **6**, 665.

A general note on the bronzing of sulphur colours. Sulphur blacks are easily recovered, but dark blues are more difficult to correct. Bronzing is especially evident when standing dyebaths are employed.

The addition of various substances to the dyebath has a limited success, but there is no method by which prevention of bronzing in the dyeing of sulphur blue can be guaranteed. The best result is obtained by treatment of the dyed material with 3% acetic acid and 2% sodium bichromate at 60° C., or by oxidation with nascent chromic acid, but the shade becomes greener and brighter. If the colour in question is a reddish blue a 1% solution of sodium perborate at 60° is used, and better results are obtained if the material is previously rinsed with a solution of sodium sulphide. —B.C.I.R.A.

Artificial Silk: Dyeing Properties. A. Oppé. *Melliand's Textilberichte*, 1925, **6**, 685-687.

The possibility of testing the dyeing properties of artificial silk without the application of dye tests has been examined. Dye tests on test pieces woven with a cotton warp, and corresponding determinations of counts, filament number, twist, strength, and extension at break were made, and also in certain cases copper number determinations and zinc chloriodide tests. Dye tests indicate that a batch of artificial silk practically never behaves uniformly throughout in dyeing. Differences in dyeing properties find no parallel differences in counts, twist, strength, or extension at break, nor in cross section. Paler dyeing material gives a higher copper number and a deeper iodine colour than deeper dyeing material, but the results are only of limited value. Polarised light reveals no typical differences. The size of the colloid particles comprising the gel appears to be the dominant factor affecting dyeing properties, so that where two samples of artificial silk of the same kind have different dyeing properties, the sizes of the component particles are different. This would account for the significance of the chemical tests. A general method of obtaining a level-dyeing product by influencing the size of the particles is not available. —B.C.I.R.A.

Naphthol AS Colours on the Fibre; A Microscopical Method for the Investigation of——. L. Lochner. *Melliand's Textilberichte*, 1925, **6**, 914-916.

A small sample of the material (about 0·1 gram) is covered with glacial acetic acid in a test-tube. After boiling for a short time the solution is poured on to a clock-glass. A few drops are then placed on a microscope slide. The crystals which separate out are examined at a magnification of about 500. The shape and colours of the crystals give an indication of the dyestuff which is present. The colour of the acetic acid solution often affords useful information, and a further guide is given by the behaviour of the dyed material with strong sulphuric acid. The test may also be supplemented by heating a sample of the dyed material with a solution of sodium sulphide in order to determine with which base the naphthol is combined. —L.I.R.A.

Indigosol; Advancements in Dyeing by the Use of——. G. Friedlander. *Melliand's Textilberichte*, 1925, **6**, 916-917.

Describes a number of dyeing and printing processes for which Indigosol is specially suited, including a number of discharge and reserve effects which may be obtained by using Indigosol in conjunction with dyes of other classes. The author also refers to the use of Indigosol for obtaining photographic reproductions on fabrics. —L.I.R.A.

Dyeing. G. Rossi and A. Basini. *Chem. Zentr.*, 1925, **i.**, 2115 (from *Annali Chim. Appl.*, **15**, 4-16).

Dyeing is a simple adsorption process. For a series of dyestuffs it is shown that the quantity of dye withdrawn by fibres from the dyebath is always a function of the concentration of the dyebath. The adsorption of Methylene Blue, Ponceau 2R, Light Blue, and Congo Red was studied. —B.C.I.R.A.

Dyeing Cotton in the Padding Machine with Vat Dyes. *Textile Colorist*, 1926, **48**, 39-40.

A description of the methods employed. —A.J.H.

A Dyeing Fault: Method of Correction. F. C. Goodall. *Dyer and Cal. Printer*, 1926, **55**, 8.

In certain instances grey woollen fabric consisting of a mixture of white wool and wool dyed by means of dyestuffs of the Eriochrome Black T type, develops a slight yellow cast during finishing. This fault is due to a yellowing of the white wool and due to the presence of free sodium carbonate remaining in the fabric after scouring and milling. The fault is corrected by thorough washing or slight acidification of the fabrics after milling. —A.J.H.

Artificial Silk: Dyeing. E. Greenhalgh. *Dyer and Cal. Printer*, 1926, **55**, 6-7, 26-27.

A discussion of the physical and chemical properties of the various types of artificial silk in relation to processes of dyeing and faults associated therewith. "Bar" effects in artificial silk goods are largely due to the presence of silk yarns of uneven denier, and may be largely avoided by suitable methods of weaving; chemical treatments have failed to eliminate this fault. Certain inorganic salts, such as phosphates and silicates, are used as protective agents in the scouring of viscose silk. The use of antichlor substances after bleaching is essential. —A.J.H.

Dyestuffs and Pigments: Classification. C. E. Mullen. *Textile Colorist*, 1926, **48**, 25-27.

A classification of commercial dyestuffs and pigments as regards their trade name, method of application, and manufacturer. —A.J.H.

A Comparison of the Shade of Cottons of Different Growths when Dyed Together in the Same Bath. D. A. Clibbens and B. P. Ridge. *J. Text. Inst.*, 1925, **16**, T.305-T.310.

(J)—Printing

Bronze Printing; The History and Development of——. O. Gaumnitz. *Melliand's Textilberichte*, 1925, **6**, 923-927.

Describes, with recipes, various methods which may be employed for obtaining bronze effects on fabrics. —L.I.R.A.

Hydron Dyes for Cotton Printing. *Melliand's Textilberichte*, 1925, **6**, 945 (from *Text. Colorist*, 1925, **48**, 224-225.

Recipes are given for the use of the Hydron (Cassella) vat dyes in direct printing and in discharge and reserve printing. —L.I.R.A.

Coloured Design Projecting Apparatus. L. C. Martin. *Sci. Abstr.*, 1925, **28B**, 459 (from *Illum. Eng.*, 1925, **18**, 126).

The author describes a projector of special design, due to C. F. Smith, by means of which it is possible to project on to a screen a number of superposed images. Each of these images may represent that portion of a complicated design which is to be coloured in a single colour. The superposition of the images then gives the appearance of the complete design. Each image can be readily changed both as regards colour and brightness, and thus the effect of such changes in any given design of, for instance, a wallpaper or a cretonne, may be studied with minimum trouble. —B.C.I.R.A.

Calico Printing. W. B. Nanson. *Cotton*, 1925, **89**, 1235-1238.

In this, the concluding article of the series, the author deals with the application of the direct dyeing colours, the "loose" steam style and iron buff and manganese styles. —B.C.I.R.A.

Notes on the Printing of Artificial Silk Goods. R. Sansone. *Text. Colorist*, 1925, **47**, 289.

All rayon goods are generally printed with blocks, but mixtures with cotton or wool are done in roller machines. A large range of bright colours may be used, as the material is not suitable for ordinary washing, being either dry cleaned or only mildly soaped. In the course of printing the temperature of washing and steaming must not rise above 90° C., or the lustre of the rayon will suffer. Owing to the tenderness of the fibre when wet, the greatest care must be exercised at every stage. Rayon is sometimes printed in the skein to get the effect of dyeing and of ombrée or rainbow. This cuts out the waste of dyes, and is recommended for small quantities of rayon. Rayon warps are printed similarly to other fibres. Cuts are introduced of a variety of printing machines. —F.G.P.

Developments in Calico Printing. R. Sansone. *Dyer and Cal. Printer*, 1926, **55**, 50-51.

A roller washing machine for clearing or fixing printed fabrics is described, the machine being fitted with a type of spring pressure such that mechanical damage to the fabric is avoided. —A.J.H.

Improvements in Stentering Processes. H. D. Martin. *Text. Colorist*, 1926, **48**, 19-20.

The disadvantages of pen stenters as compared with clip stenters for finishing cotton fabrics are (1) slow rate of production, (2) permanence of pin holes formed in the selvages, (3) increased possibility of damage to fabric, and (4) higher cost of repair. So that the production of "baked" fabric may be avoided before stentering, the drying cylinders are preferably placed after the stenter, but if placed between it and the padding mangle, they should be immediately followed by a steaming box, which may be operated as desired. Dry fabric should be passed through hot water before entering the padding mangle. —A.J.H.

(K)—Finishing

Lactic Acid; Uses of——. N. Bourguignon. *Chem. Abstr.*, 1926, **20**, 113 (from *Tiba*, 1925, **3**, 1033).

Brief review in original of the properties of lactic acid, its utilisation for producing silk effects, and its technical control. —B.L.R.A.

"Lanolinification" of Cotton: Permanent Dressings. E. Justin-Mueller. *Chem. Abstr.*, 1925, **19**, 3596 (from *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 399-400).

"Lanolinification" is a treatment giving to cotton the feel of wool and the permanent stiffness of flax fibres, consisting in impregnating the dyed, bleached, or merely boiled fibre (yarn or fabric) with a solution of albumin containing a soluble oil, paraffin, or stearin, with a suitable solvent and formaldehyde, letting stand overnight in a moist condition, steaming 15-20 minutes without previous drying, passing through a bath of an aluminium salt, rinsing, washing, and drying. Steaming fixes the albumin, and the formaldehyde gives a much softer feel, like that of wool. Report—Jacques Leonhart, *Ibid.*, 400-1. Leonhart found the above treatment to

give the feel of flax, but did not observe the action claimed for formaldehyde. Soluble oil and paraffin, rather than formaldehyde, gives a soft feel. The process is not applicable to white goods, as they yellow on steaming. The process cannot compete commercially with Heberlein and Co.'s concentrated sulphuric acid process, evolved during the war. —L.I.R.A.

Modern Processes for the Improvement of Textile Materials. —. Schwarz. *Leipziger Monats.*, 1925, **40**, 481-484.

This is the last of a series of four articles in which the author reviews a considerable number of processes, mainly relating to vegetable fibres, which aim at producing various modifications in the feel and appearance (lustre, transparency, &c.) of yarns and fabrics. With cotton materials, silk-, wool-, and linen-effects may be produced by treatment with strong solutions of acids and alkalies, either alone or used alternately. Variations in the strength, temperature, and time of action of the reagents and in the sequence in which they are used lead to different results, and are embodied in numerous patents. Strong solutions of various salts, for example, zinc chloride and calcium thiocyanate, may also be used for the production of various finishes. —L.I.R.A.

Housings for Stenter Frames. *Textile Colorist*, 1926, **48**, 42-43.

Details are given of costings comparing the performances of two 50 ft. stenters, one housed in an ordinary wooden chamber and the other in a Proctor housing supplied with fans for circulation of hot air. The Proctor housing allowed the speed of the stenter to be increased from 56 to 75 yards per minute, and the steam consumption decreased from 3·5 to 2·0 lbs. per 1 lb. of water evaporated from the fabric. —A.J.H.

Caoutchouc Latex; Impregnation of Cotton Fabrics and Yarns with——. J. F. S. *L'Avenir Text.*, 1925, **7**, 619-622.

The method used for impregnation with caoutchouc latex is described. It is found that the latex penetrates the interstices of cotton much more thoroughly if it has been bleached before latex treatment. The greatest change in yarn and cloth properties produced by the impregnation is the increase in resistance to wear. It is put forward as probable that latex impregnation would be effective in increasing the durability of the canvas of motor tyres. —L.I.R.A.

The Weighting of Natural Silk. *Silk Jl.*, 1925, **2**, No. 15, p. 37.

The morality of putting more weighting material into a fabric than there is silk, and then selling it as silk is questioned. It is compared to the addition of water to get the full (or increased) weight of woollens. When 16 oz. of silk weighs 80 or 90 oz., the word "fraud" should be plainly stamped on every yard. It is stated that heavily tin-weighted silk is liable to self-ignition. The tin-phosphate-silicate method of weighting is described. Japanese silk is said to be more easily weighted than other kinds. The theory of the process is considered to be not definitely decided. —F.G.P.

Acids on Cotton. *Chem. Abstr.*, 1925, **19**, 3377 (from *Chemicals*, 1925, **24**, 31).

A discussion of the various patents covering the use of H_2SO_4 and HNO_3 on cotton. —B.L.R.A.

Lustre in Textile Fabrics. *Text. Rec.*, 1925, **43**, No. 512, pp. 65 and 67.

The meaning of lustre is discussed. The attempts which have been made to measure this property of textiles are referred to, and the value of comparative tests is pointed out. The various factors, such as fibre, twist, weave, mercerising, schreinering, finishing, &c., which give lustre to a cloth, are explained. The lustre of rayon, the application of this material to costume cloths, men's wear fabrics, &c., in combination with wool, and the necessity of subduing or diffusing its effect in such fabrics, are discussed. For reducing finishing costs it is stated to be an advantage for the lustre to be in the fibre rather than in the finish. —L.I.R.A.

What is "Twenty-five per Cent. Weighting?" J. Chittick. *Silk* (N.Y.), 1925, **18**, No. 6, p. 77.

A crêpe georgette made of white Japan silk will have a boil-off of about 19%, which, with 6% of added soap and oil, brings the total loss to 25%. If the manufacturer orders 25% weighting, he expects back 125 lb. for each 100 lb. of silk sent. One may assume that 25% is 25 lb. of the returned weight, that is 20% of the total. Another may consider that 25% of the total is 31¼ lb. of weighting to 93¾ lb. of silk. It may be held that 25% of the 75 lb. of boiled-off silk, or 18¾ lb., is weighting. Of course, if 125 lb. be returned for 100 lb. sent, 50 lb. of weighting has been added, which is 40% of the total weight of silk, 50% of the original gum weight, or 66⅔% of the boil-off weight. The latter is the real meaning of 25% weighting, and is said to be standard practice. —F.G.P.

Odours in Woollen Piece Goods. *Dyer and Cal. Printer*, 1926, **55**, 48.

Although wool itself has the property of retaining odours persistently, objectionable odours in wool are usually due to the presence of soaps, and ~~it is~~ therefore advisable to thoroughly remove such substances before finishing. —A.J.H.

PATENTS

Ornamenting Fabrics. The Sales Finishing Plants, Inc. E.P.218,327 (from *Dyer and Cal. Printer*, 1926, **55**, 27).

Permanent, insoluble, and non-thermoplastic effects on fabrics are obtained by printing, and subsequently heating at 110°-130° C., fabric with a condensation product obtained from phenol or cresylic acid with formaldehyde. —A.J.H.

Formic Acid: Application. J. Pokorny. F.P.573,739 (from *Chem. Zentr.*, 1925, **i.**, 1134).

Plant fibres are treated with concentrated solutions of formic acid to improve their lustre and absorptive power for dyes. —B.C.I.R.A.

Elagic Acid Mordant: Application. Soc. Alsacienne de Produits Chimiques. F.P.575,652 (from *Chem. Zentr.*, 1925, **i.**, 1016).

Elagic acid may be used as a mordant for fixing basic dyes on cotton. The acid is heated with sulphur and caustic soda or sodium sulphide until the evolution of hydrogen sulphide ceases; after cooling, air is passed through, and the liquid is acidified. The product is soluble in alkali, and penetrates cotton on addition of sodium carbonate, sodium sulphate, or sodium chloride; it serves as a substitute for tannin for fixing basic colours, and the dyes are faster to washing and to soap than those fixed with tannin. —B.C.I.R.A.

Tannin-Tartar Emetic Reserve: Application. J. Pokorny. F.P.575,818 (from *Chem. Zentr.*, 1925, **i.**, 1016).

Vegetable fibres are treated with tannin and tartar emetic; by interweaving treated and untreated yarn and dyeing with substantive dyes, variegated colour effects are obtained. If cotton fabrics are printed with a thick paste of tannin and a basic dyestuff, then steamed and treated with tartar emetic, true colour resists are obtained on dyeing with substantive or vat dyes. —B.C.I.R.A.

Cellulose Acetate Silk: Dyeing. Société pour la Fabrication de la Soie "Rhodiaseta." F.P.579,896 (from *Chem. Zentr.*, 1925, **i.**, 1654).

In dyeing cellulose acetate articles with basic dyestuffs, there are added to the dyebath aromatic sulphonic or carboxy-acids, which may contain phenolic groups, such as benzoic acid, hydroxy-benzoic acids, benzene- and toluene-sulphonic acids, &c., or their water-soluble salts. Since many of the compounds are soluble in cellulose acetate gels, they may be added to the acetate before spinning, and the filaments prepared in this way may be dyed with basic dyes without further treatment. —B.C.I.R.A.

Cotton Fabrics: Lustring. C. Mayer. F.P.582,390 (from *Chem. Zentr.*, 1925, **i.**, 1826).

Vegetable fibres are given a silk-like appearance by superficially coating them with cellulose esters. For example, a cotton fabric is immersed in dilute sulphuric acid and washed until acid-free; the fabric is then put into a solution of cellulose acetate in acetic anhydride-acetic acid, into a solvent for cellulose acetate, and into a condensing agent such as sulphuric acid or pyridine; and finally through a series of baths containing cellulose acetate solution in which acetic acid and acetic anhydride are trapped. The finished product has a brilliant lustre. —B.C.I.R.A.

Cotton Fabrics: Lustring. C. Mayer. F.P.582,391 (from *Chem. Zentr.*, 1925, **i.**, 2049).

The fabric is treated with a cold solution of sodium or potassium hydroxide, then with a solution of ammoniacal copper oxide or alkali-thiocarbonate; it is then put through a solution of cellulose in ammoniacal copper oxide or viscose, then through an acid or caustic alkali bath, and after washing, calendered. The resulting fabric possesses a much brighter lustre than mercerised cotton, and a much greater strength than viscose or cuprammonium artificial silk. —B.C.I.R.A.

Fabrics: Printing. F. Deshayes. F.P. 582,956 (from *Chem. Zentr.*, 1925, **i.**, 2468).

A permeable substance such as cotton or paper is steeped in the dye solution, and is then passed with the material to be printed through a pair of cylinders, one of which is provided with the required pattern in relief; the imprinted colour is fixed with steam. —B.C.I.R.A.

Bleaching Kier. R. Mohr. D.R.P.311,456 (from *Chem. Zentr.*, 1925, **i.**, 1015).

By means of an air pump the expansion vessel is subjected to a pressure just below that of the bleaching kier in order to ensure overflow from the kier into the expansion vessel. The difference in pressure between the expansion vessel and the kier is maintained by a pressure regulating device inserted between the two, which consists of two connected pressure cylinders, the requisite pressure difference in the cylinders, i.e., between the kier and the expansion vessel, being maintained by means of a valve regulator on the pressure inlet. —B.C.I.R.A.

Cold-Swelling Starch Products: Preparation. H. Wulkan. G.P.389,024 (from *Chem. Zentr.*, 1925, **i.**, 2670).

The cold-swelling starch products previously described can be subjected to the usual dextrinisation processes. The products obtained differ from normal dextrins in that, even with much water, they form thick, more or less transparent, jellies,

which can be used as cold adhesives, for finishing fabrics, thickening printing colours, &c. —B.C.I.R.A.

Mordant Dyes: Application. Farbenfabriken vorm. F. Bayer & Co. D.R.P. 408,294 (from *Chem. Zentr.*, 1925, i., 1654).

Fast colours are obtained on fibres by steeping in a mordant dyestuff bath at ordinary temperature, and, after drying, treating with a solution of chromium chloride at the same temperature. In this way steaming is unnecessary; the method is applicable to Java-batik dyeing. —B.C.I.R.A.

Union Fabrics: Dyeing. Farbwerke vorm. Meister, Lucius & Brüning. D.R.P. 408,404 (from *Chem. Zentr.*, 1925, i., 1654).

The sulphur colours are used to dye the vegetable fibres in wool-cotton and other textile fibre mixtures. The sulphur colours are reduced and dissolved by the action of alkali carbonate and hydrosulphite, with or without the addition of substances of a colloidal nature, such as casein, sulpholeates, soap, &c. Dyeing is carried out at ordinary or at higher temperatures. The colours obtained are fast to milling, washing, light, and cross dyeing, and the wool is not injured. —B.C.I.R.A.

Aniline Black Vat Dye Reserve: Applicacation. R. Haller and F. Kurzweil. D.R.P.408,414 (from *Chem. Zentr.*, 1925, i., 1654).

The fabric is steeped in a bath of aniline black and dried. It is then printed with a medium containing the vat colour, the reducing agent, and the substances forming the black resist. The aniline black is then developed by steaming, the fabric is treated with hot caustic soda solution, washed, and dried. The vat dyestuff is by this means fixed on the fibre without the appearance of any white edges to the colours printed on it. —B.C.I.R.A.

Starch Emulsions: Preparation. W. Leonhardt. D.R.P.408,523 (from *Chem. Zentr.*, 1925, i., 1821).

Starch paste is warmed with very small quantities of acids or acid salts, and the mixture is then further heated with caustic alkali in excess until the starch is broken down. The alkali is then neutralised with acid. The emulsions are not precipitated by basic salts, and should find application in laundering, finishing, and calico printing. —B.C.I.R.A.

Cold-Swelling Starch: Preparation. Chemische Fabrik Mahler and Supf. A.G. D.R.P.409,958 (from *Chem. Zentr.*, 1925, i., 1820).

Water, or water containing chemicals such as ammonia, is dropped on to starch heated above the pasting temperature, and in such a way that the temperature at the moment of admixture of the water drops with the starch particles, does not fall below the pasting temperature. In this way a granular paste is obtained. The granules may be dried in the hot starch mass or may be separated and dried, and are then ground. —B.C.I.R.A.

Oxygenated Liquor Bleaching Kier. R. Mohr. D.R.P.410,106. (from *Chem. Zentr.*, 1925, i., 2117).

The bleaching kier, after filling with the goods and with the bleach liquor pumped in under a pressure of about two atmospheres, is put under further pressure by pumping in pressure-air or gas, and the pressure in the kier is kept constant during the further treatment of the goods with fresh supplies of bleach liquor. In operation the kier is joined to a pressure vessel connected to a compressor, which can be regulated during working. The pressure vessel is provided with a liquid level gauge, and takes up from the kier the excess liquor required for penetration of the goods by the bleach liquor. The pressure vessel forms a detachable dome-shaped lid on the kier, and shuts off the filling inlet of the latter. With small quantities of liquor a rapid and uniform bleaching action is obtained. —B.C.I.R.A.

Vat Dyes: Discharging. Badische-Anilin and Soda Fabrik. D.R.P.410,302 (from *Chem. Zentr.*, 1925, i., 2665).

A method of producing variegated colour effects on cotton dyed with vat dyes involves printing with an alkaline reducing paste which is also capable of developing naphthol derivatives possessing an affinity for fibres, appropriately in the presence of benzyl ammonium compounds or of substances with similar action; and, after steaming, treating the printed fabric with diazo-compounds. Naphthol derivatives are cited, and include oxynaphthoic acid, arylide, &c. In addition to the naphthol discharge paste, the ordinary reducing discharge pastes may be printed on the cotton dyed with vat dyes, in which event white effects are obtained in addition to variegated colour effects. —B.C.I.R.A.

Imitation Silk Yarns: Preparation. Maschinenbau-Anstalt Humboldt. D.R.P. 413,818 (from *Chem. Zentr.*, 1925, ii., 789).

A silk-like lustre is produced on vegetable fibre yarns by parchmentising the yarns by treatment with sulphuric acid, zinc chloride solution, or similarly active solutions, and mechanically polishing them by drawing over hooks. Very thin threads with a smooth lustrous surface are obtained. —B.C.I.R.A.

Protection Against Moth. G.P.416,706 (from *J. Soc. Chem. Ind.*, 1926, **45**, B47).

Protection of furs, fabrics, &c., against moth is produced by impregnation in a benzene solution of antimony soap. —B.L.R.A.

Degreasing Raw Wool. A. M. Bruckhoff, Dahlem, Berlin. E.P.241,314.

Raw wool, preferably dried till it contains about 2% or 3% water, is degreased by treatment with liquid acetone so as to leave from 2% to 5% of fat in the wool. According to one method the raw wool is treated at room temperature in a tightly closed extractor with three to five times the quantity of acetone. After half an hour the extract is withdrawn, the wool treated with fresh acetone, and finally washed with water. Another method is also described. —H.L.R.

Aromatic Sulphochloramides: Preparation and Application. Farbenfabriken vorm. F. Bayer & Co., Leverkusen, Germany. E.P.241,579 and 241,580.

Alkali salts of aromatic sulphochloramides are prepared from aqueous solutions of the sulphonamides or salts thereof by adding bleaching powder and treating the product with an alkali salt which will precipitate the calcium. Stable mixtures for use in washing, bleaching, and disinfecting, which yield salts of sulphochloramides when added to water, are prepared by mixing a sulphonamide or one of its salts with a hypochlorite. Mixtures yielding sulphohalogenamides containing halogens other than chlorine may be prepared by similar processes. A salt may be added to the mixture which precipitates the metal of the hypochlorite, &c., as an insoluble soap to avoid the formation of an insoluble soap when the mixture is used for washing. According to one example, bleaching powder is mixed with *p*-toluenesulphonamide, and in a second calcined soda is added to a mixture of these two substances. In a third example, bleaching powder, potassium toluenesulphonamide, and Glauber's salt are mixed together. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Dyeing—

241,487. Smith, Drum & Co. Rotary dyeing machine cylinder.

241,854. Chemical Works, formerly Sandoz. Resist process for yarns and fabrics.

Printing—

241,246. Know Mill Printing Co. Ltd., T. L. Mort, and F. W. Weeks. Spraying, printing, and stencilling process.

Finishing—

241,696. A. A. Whitley and A. E. Simpson. Tentering machine.

241,706. W. Bowden. Fancy edging for knitted fabrics.

5—LAUNDERING AND DRY CLEANING

Detergent Action Revealed by the Graphite Test; Fundamental Principles of——. R. M. Chapin. *J. Ind. Eng. Chem.*, 1925, **17**, 1187-1191.

The graphite test for detergent efficiency is shown to be valuable for investigating the fundamental principles of deflocculation and of detergency. Concentration-temperature curves of various soaps are presented which afford data for a more complete theory of deflocculation and detergency than heretofore established. The data and theory cover the effect of (*a*) crystalloidal soap, (*b*) colloidal soap, (*c*) free fatty acid, (*d*) acid soap, (*e*) nature of fatty acid, and (*f*) nature of alkali. In particular, it is shown that the colloidal fraction of a soap is inert as a detergent at equilibrium. —L.I.R.A.

Soap Solutions: Ageing. R. M. Cobb. *J. Ind. Eng. Chem.*, 1925, **17**, 1134-1135.

A study of the effect of age on the emulsifying and lathering powers of soap solutions. Under given conditions the emulsifying power of a sodium oleate solution varies 10% within an hour, and is affected by temperature, carbon dioxide, and oxygen. Over a 12-hour period the fluctuations in emulsifying power seem periodic. In the lathering tests, there was no regularity in the behaviour of the different solutions; the lathering power of a solution of commercial soap may vary 25% in tests made half an hour apart. The results are not very conclusive, but the phenomenon of ageing is attributed to progressive hydrolysis of the solutions. —B.C.I.R.A.

Advantages of Burnus. P. Heerman. *Wascherei Zentralblatt*, 1926, **25**, 1.

The advantages of Burnus over Wermil—an enzyme free detergent—and soda are emphasised. Two kinds of dirt were used —cocoa + milk, and indigo. In both cases Burnus proved superior to the other. —B.L.R.A.

Utility of Detergents Containing Peroxides for Textile Materials. K. Brauer. *J. Soc. Chem. Ind.*, 1925, **44**, B752 (from *Chem. Zeitung*, 1925, **49**, 505-6 and 526-8).

The results obtained by comparison of the detergent values of a washing powder containing sodium perborate, soap powder, and soap in the removal of coffee, milk, wine, oil, blood, rust, ink (iron-free), and particularly cocoa stains from cotton fabric confirm the author's previous conclusions that washing powders containing peroxides are more efficient than ordinary soap

detergents, and that, contrary to the statements by Heermann, such oxidising preparations have no marked deleterious action on the strength of the fabrics treated. Experiments in which the stained fabrics were rubbed with metallic copper and afterwards cleansed in copper vessels indicated that there is little probability of the ordinary catalytic activity of copper causing damage to fabrics during ordinary processes of washing by means of detergents containing peroxides. —L.I.R.A.

Investigation of Methods for Washing Textile Materials with Special Reference to Use of Perborates. T. Madsen. *J. Soc. Chem. Ind.*, 1925, **44**, B799 (from *Chem. Zeitung*, 1925, **49**, 633-635).

Investigation of the washing of cotton and linen fabrics in laboratory and large scale trials by means of detergents, such as soap, sodium carbonate, sodium sulphite, potassium hydroxide, potassium persulphate, washing powders, water-glass (sodium silicate), and sodium perborate show that perborates markedly affect the strength of the fabrics. The addition of water-glass to detergents tended to prevent deterioration of fabrics during washing, but this effect was probably due to the formation of insoluble substances within the fibres, the latter being shown to have an increased ash content. The use of caustic soda instead of sodium carbonate had no significant effect on the deterioration produced during washing. Fabrics gained strength when calendered after washing. The mechanical treatment suffered by cotton and linen fabrics during washing produces much less deterioration than that caused by the action of detergents, the effect of the latter being greater on linen than on cotton. Detergents containing perborates produce more deterioration than those free from perborates. —L.I.R.A.

Patents

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Laundering—

241,352. British - American Laundry Machine Co. Reversing gear for washing machine with rotary receptacles.

241,734. H. Wade. Process to prevent decomposition of soap.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Fibres: Moisture Relations. J. Obermiller. *Z. angew. Chem.*, 1925, **38**, 838-839.

In connection with the importance of controlling relative humidity in textile mills, series of experiments have been made on the relation between the moisture content of fibres and the humidity of the surrounding air. They were carried on, without interruption, for more than two years, at several different humidities and at a constant temperature of 20°, and moisture curves for the fibres have been drawn. These curves show that in absolutely dry air fibres lose all trace of moisture, even at ordinary temperatures; in moist air, wool, silk, cuprammonium, and viscose silk, and cotton appear to take up, respectively, more than 32, 35, 40, and 26% of moisture calculated on the dry weight of the fibre. Some 10,000 measurements of the strength of single fibres were made by a special method, and the following figures for "relative wet strength" are given—Cotton 110-120%, cellulose acetate silk 65-70%, cuprammonium silk 50-60%, viscose silk 45-55%, nitro-silk 30-40%. —B.C.I.R.A.

Weaving Faults. *Rev. Textile*, 1924, **22**, 571-575.

The author enumerates common faults met with in fabrics and which are attributable to the weaver rather than to failure of the thread or the loom. Selvage faults are dealt with in some detail, and the proper numerical relation which must be preserved, for a good selvage, between width of the warp on the beam, at the harness, at the reed, and in the fabric are indicated. The effect of uneven tension in causing slack or curved warp threads due to an inefficient tension frame is illustrated. —B.C.I.R.A.

Cotton Yarn; Swelling of——. E. Justin-Mueller. *Rev. Gén. Mat. Col.*, 1925, **29**, 197-199, 232-235.

Turgoids are defined as organised substances which swell without dissolving in water or aqueous solutions. The principal turgoids are the textile fibres, skins, physiological tissues, wood fibre, leather, and to a certain point rubber. Experiments have been made on the swelling, in sodium hydroxide solutions, of 27°, 30°, and 37° Bé., and in sulphuric acid solutions of 40°, 50°, and 60° Bé., of raw cotton and of the same cotton boiled-out and bleached. Curves showing the results are reproduced. It is concluded that swelling is the result of hydration and that the action of sodium hydroxide on cellulose is not due only to the effect of the alkali, but is due conjointly to the alkali and to hydration. The action of the alkali is greater as hydration is more pronounced. —B.C.I.R.A.

Silk and Its Testing. J. O. Thompson. *Text. Colorist*, 1925, **47**, 221.

Testing silk serves to fix a value, though not necessarily a price, and it assists in the choice of a particular lot of silk for a definite purpose. Silk fibre differs from cotton and wool in its length of staple, being in, roughly, 1,000 yard units; breeding, climate, and biological influences have all their effects on the nature of the fibre. It is stated that one ounce of newly hatched silkworms will consume 1½ tons of mulberry

leaves by the time they are ready to spin. Silk fibre runs about 110,000 yards to the ounce. Cold water dissolves only slight traces of sericin, boiling water about 9½% in three hours. Raw silk is physically examined for defects. It is considered by Seem that loops at the rate of 4 in 30 yards are not objectionable, as they do not show. Silk is said to be able to take up 30% of moisture, and not to feel wet with 18%; 11% is the normal content. The moisture must be ascertained in order to avoid losses in buying; the amount is calculated on the dry weight. —F.G.P.

Silk and Its Testing, II. J. O. Thompson. *Text. Colorist*, 1925, **47**, 293.

The boil-off, although it varies considerably, does not enter, it is stated, into contracts for purchase of raw silk, but the estimation must be carried out in the clearance of thrown silk. The gum in raw silk varies from 16% to 22·5%, in thrown silk, owing to absorption of soap and oil, it ranges from 24%-27%. The reeling basins accumulate a considerable quantity of gum, some of which may be picked up by the silk if the temperature is reduced; soft water should be used, as silk absorbs mineral matter. The moisture and gum content of silk must be estimated before and after throwing. The test is to boil twice for ½ hour in fresh soap solutions containing good quality soap in amount equalling 25% of the silk. The various quantities should be standardised. After the first boil the samples are squeezed out and rinsed three times in warm water. After the second they are squeezed, washed first with warm water, then in dilute acetic acid, again in warm water, and then dried. Lousiness may possibly be due to excessive boiling-off, indicating that not only the sericin but also part of the fibroin has been removed. Opinions appear to be divided between the degumming and dyeing as a cause of this defect. —F.G.P.

Silk and Its Testing, III. J. O. Thompson. *Text. Colorist*, 1925, **47**, 370.

Silk comes on the market in skeins of about 3 oz., running 55,000 yards per skein and 310,000 yards per lb. The commonest size is 13/15 den., requiring 500 threads to cover 1 in., a variation of 20% is permissible. Separate cocoon filaments average about 2·5 den., ranging from 3·2 to 1·9. This varies in different silks. A bale of Japan silk contains 30 books of 30 skeins. For testing it is usual to take 20 skeins from different books; 20% of the bales should be sampled. As it is easier to get a skein from the inside of a book than the outside, the best skeins are usually put inside. Only skeins from one bale should be included in any single test. A lustrous, dense thread is usually strong, and has good cohesion. If a thread breaks short with a snap it denotes strength; if it pulls apart with a frayed end it tells of low cohesion. Streaky and discoloured silk may cause shadiness in piece dyeing. If silk has been reeled from dirty water it will look grey and dull, but this will be removed when the material is degummed. A silk of high cohesion is of high lustre, but the converse is not always true. —F.G.P.

Silk and Its Testing, IV. J. O. Thompson. *Text. Colorist*, 1925, **47**, 431.

The size of silk in deniers is a measure of weight rather than size. The weight of 450 metres (492 yards) in ½ decigrammes is the legal method of stating deniers. The Americans are said to weigh skeins of half that length, and consider that by so doing there is less chance of light and heavy places averaging together. In spite of this, however, the Raw Silk Classification Committee has put a standard reeler on the market that stops automatically when 450 metres is wound on the bobbin. The test is conducted in a standard atmosphere which will produce 11% regain. The winding test should be made by real winders, not in the laboratory; the Grant reel is the standard. The numbers of breaks in 100,000 yards are counted; up to 5 is excellent, over 30 very poor. Silk is soaked before winding to soften the gum-tacks on the skein. Although silk runs better when damp, to wind it in that condition would impair the quality owing to the strain at the end of the skein. Alkaline soaps may cause trouble by weakening the fibre. —F.G.P.

Simplest Tests of Artificial Silks. *Text. Colorist*, 1925, **47**, 441.

The United States Bureau of Standards has issued the following tests for Rayon—Treat a sample with equal parts of concentrated sulphuric acid and iodine. Viscose turns dark blue, cuprammonium light blue, nitrocellulose violet, acetate cellulose yellow. The first two then are treated with conc. sulphuric acid only, and the colour observed after 15 minutes. Viscose turns red-brown, cuprammonium yellowish-brown. —F.G.P.

Miscellaneous Reactions for Rayon. *Text. Colorist*, 1925, **47**, 177.

Ruthenium Red, ruthenium oxychloride with ammonia, $Ru_2(OH)_2Cl_4(NH_3)_7{\cdot}3H_2O$, may be used to distinguish between cuprammonium and viscose; the latter is coloured pink, the other remains white. Denitrated nitro-rayon is coloured red, changing to violet on prolonged standing. Naphthylamine Black 4B colours copper-rayon dark blue and viscose light blue in a neutral hot bath. Acetate rayon dissolves in glacial acetic acid, others do not. Diphenylamine is coloured blue by nitrocellulose fibres; the others do not affect it. Methylene Blue dyes viscose a deep shade, nitro distinctly, copper faintly, acetate

irregularly. Tests should be made on known fibres for practice in the methods. —F.G.P.

The Ostwald Viscometer as a Consistometer. W. H. Herschel and R. Bukley. *J. Phys. Chem.*, 1925, **29**, 1217-1223.

The consistency of plastic substances must be determined by an instrument which allows determinations at varying average rates of flow. The Ostwald viscometer may be adapted to suit the case, or may be used in the usual form with an external source of pressure, as in the Bingham viscometer. In using the Ostwald viscometer as a consistometer, methods of determining the mean effective head are discussed, and a suitable equation is given for finding the magnitude of the applied pressure. By plotting the rates of flow against the corresponding pressures a curve is obtained, which shows by its form whether the body tested is viscous or plastic. The simplest method of expressing the consistency of a plastic substance is in terms of its mobility and yield shear value, both of which may be obtained by calculation from the data in the above-mentioned curve. —L.I.R.A.

Plasticity in Relation to Cellulose and Cellulose Derivatives. S. E. Sheppard and E. K. Carver. *J. Phys. Chem.*, 1925, **29**, 1244-1263.

Measurements using sols of cellulose and cellulose esters showed them to be plastic in the sol state. This plasticity has been shown to be more evident in the transition stage from sol to gel and from gel to sol. It may be attributed to formation of structures in solution. Elastic behaviour at the limiting concentration of gels shows similarity to a ductile metal, instead of to rubber, a typical organo-colloid giving sols and gels. This difference has most probably a bearing on theories of structure. Solid rubber prepared by coagulation from aqueous suspension or by evaporation from organic solution yields substances having the same elastic properties. The fundamental properties of the rubber solid are due to ultimate rubber particles, and are only modified in secondary ways by structure and aggregation of these; that is, there is a similarity to the case of metals where properties depend on the atomic lattices in the crystal. The process of aggregation of particles in cellulose ester sols and gels to form a solid resembles more that of rubber than of metals, yet the resultant solid is more like a ductile metal as regards elasticity. A knowledge of the structure of the ultimate particle is essential. An hypothesis for the structure of gels on the type of the dynamical model of Shorter for fibres would specify a filar phase consisting of chains of micelles or molecules—such fibrils being broken on shearing, but capable of recovery to some extent. —L.I.R.A.

Hydrogen Peroxide by Oils on Exposure to Light; Evolution of——. G. F. A. Stutz, H. A. Nelson, and F. C. Schmutz. *J. Ind. Eng. Chem.*, 1925, **17**, 1138-1141.

A series of experiments on the evolution of hydrogen peroxide from a number of different oils. The amount of peroxide evolved was measured by estimating its effect on a photographic plate, the greater the quantity of peroxide the greater the opacity of the image produced. This is a preliminary paper. —L.I.R.A.

Specific Gravity of Concentrated Solutions of Orthophosphoric Acid. W. H. Ross and R. M. Jones. *J. Ind. Eng. Chem.*, 1925, **17**, 1170-1171.

Tables and curves are given of the specific gravity of solutions of orthophosphoric acid between concentrations of 90% and 100%. —L.I.R.A.

Identification of Wood Charcoals. H. G. Tanner. *J. Ind. Eng. Chem.*, 1925, **17**, 1191-1193.

Wood charcoals studied microscopically in many cases are found to contain particles whose structure is characteristic of that variety of wood charcoal. This forms the basis of the method of identification of the wood charcoals described. —L.I.R.A.

Chemical Analysis in Silk Manufacture. II.—Oils. A. A. Cook. *Amer. Silk Jl.*, 1925, **44**, No. 8, p. 57.

The importance of analysis of the oils used for lubricating silk is insisted upon. Neatsfoot oil, which is made from the hoofs of horses, sheep, and cattle, is liable to adulteration with mineral oil. Olive oil of the grade used in silk is extracted from olive pulp with carbon bisulphide. This is sometimes adulterated with cottonseed or sesame, which are not deleterious but are considerably cheaper. Pea-nut oil is thought to be good, but it is not much used. Cocoanut oil, from its high melting point, is not suitable. —F.G.P.

Light; Deterioration of Fabrics by——. Fabrics Co-ordinating Research Committee. Dept. Scient. and Industrial Research. *First Report, Appendix I.*, pp. 10-13.

This article summarises the conclusions obtained from recent work on the subject. It has been found that the most destructive band in the sun's spectrum was that between 3,900 and 3,100 A.U. The most successful protective dye incorporated in a dope was a spirit black. The deterioration was found to be more rapid in the presence of oxygen than with other gases, and moisture appeared to accelerate the action. The addition of lead chromate to a fabric afforded considerable protection. —L.I.R.A.

Deterioration of Fabrics by Micro-organisms. Fabrics Co-ordinating Research Committee. Dept. of Scient. and Ind. Research. *First Report, Appendix II.*, pp. 14-28.

An account is given of collected researches on the deterioration of fabrics due to the action of micro-organisms. Details of tests with tentage materials under various proofing treatments are recorded, and a programme of further research in this direction is outlined. It will include the exposure of materials at stations abroad, and a subsequent examination of their microbiological flora at home. There is also a discussion of the technique employed in examining samples, and the deductions which may be drawn from the observed results, more particularly after the viscose test. The deterioration of fishing nets and other materials is also discussed at some length, with the results of tests carried out under different conditions. —L.I.R.A.

The Mechanical Testing of Fabrics. Consideration of Factors Influencing the Results of the Mechanical Tests of Fabrics. Fabrics Co-ordinating Research Committee. Dept. of Scient. and Ind. Research. *First Report, Appendix III.*, pp. 29-51.

The whole of the work described or summarised in this report deals with the determination of the breaking strength of fabrics. The influence of various factors on the apparent strength has been studied. For light materials, such as aeroplane or balloon fabrics, a specimen 6 inches long and 2 inches wide has been standardised. Attempts to overcome the disturbing effects of humidity, amounting in some cases to 25%, are described. Both wet tests and bone-dry tests have been found unsatisfactory, and the ideal method is to control the atmosphere of the testing room. Where this is impossible the effect of variations in atmospheric humidity has been found to be greatly reduced by storing the test samples for a sufficient period before testing, in a box maintained at a constant humidity by means of a tray of calcium chloride solution over which the air was circulated. The effect of the method of operation of the testing machine has been considered. An analysis is given of 2,000 tests of a cotton fabric made on an Avery (constant rate of loading) and on a Goodbrand (constant traverse) machine. The mean results were 4·7% lower in the case of the Avery machine. The average breaking time was eight seconds on the Goodbrand and 85 seconds on the Avery machine. A series of tests carried out on four Goodbrand machines of different capacity showed that the apparent strength obtained increases with the capacity of the machine. —L.I.R.A.

Oil Stained Piece Goods. *Wool Record*, 1925, **28**, 864.

Some hints of what should be done to minimise the damage of oil stains, so called "stainless" oils, have little advantage over ordinary lubricating oils, as they are just as liable of carrying a dirty metallic deposit from the bearings on to the fabric. Sperm oil is the only fixed oil which does not oxidise, but it is too expensive, and its viscosity too low, for use as a loom oil, unless mixed with mineral oil. For this purpose the latter should have a viscosity which, when mixed with the fixed oil, is about three times as great as that of pure sperm oil. As soon as a stain is noticed, treatment with a few drops of lard or neatsfoot oil should be applied, which will convert a mineral oil into a more emulsifiable compound. Stains in cream or white goods are best removed with benzine or carbon tetrachloride. For dirty oil stains a solvent containing 10% each of soap and alcohol and the remainder water, or a solution of 20% each of soft soap and glycerine dissolved in water, are recommended, followed by thorough rinsing. If after the removal of oil a metallic deposit still remains, this may be removed by using oxalic acid, or a 10% solution of HCl. This acid should be pure and not of the commercial type. —B.R.A.W. & W.I.

Defects Caused by Oil. H. Priestman. *Wool Record*, 1925, **28**, 1077.

The paper illustrates different forms of damage in cloths due to the presence of oil. In extreme cases oil had oxidised completely, drying on the outside of each fibre until it formed a varnish-like coat. As no two bobbins oxidise alike, and ordinary soap scouring might remove the oil from one whilst it was quite incapable of removing it from the next, barry pieces result, in which strongly cut lines run across a piece recurring as many times as there are different bobbins in the cloth. Difference in age of the two bobbins or in the place where they have been stored may also cause different proportions of oil to be removed in scouring, thereby causing different colours to appear either as stripes in the warp, or as bars across the piece, although no mixing of runs takes place. Reference is made to the wonderful capacity of petroleum spirit for removing oil stains, with the exception of the varnish-like coat which certain oils leave on fibres, and which only warm solvents can remove. Advantages in using solvents before dyeing are an increased brilliance of bright colour, a greater fastness of the dyes produced, and also a complete removal of grease. A disadvantage of solvents is said to be that they sometimes leave the cloth in a harder condition than when normally scoured, but this can be remedied by proper finishing methods.

—B.R.A.W. & W.I.

Viscous Flow Through Wide-angled Cones. W. N. Bond. *Phil. Mag.*, 1925, **50**, 1058-1066.

Experiments are described on the flow of liquid with negligible kinetic energy

through cones of very large angle, where peculiar results are to be expected owing to the velocity-gradient in the direction of motion and the corresponding forces due to viscosity. With covering flow through cones of semi-angle not greater than 90°, the velocities and reversal of radial pressure gradient agree with the theory. For larger angles of cone a reversal of velocity is found, but not in the way predicted by the theory. One of the postulates is not satisfied, and the theory is therefore not applicable. —L.I.R.A.

Cellulose: Thermal Decomposition and Hydrogenation. A. R. Bowen, H. G. Shatwell, and A. W. Nash. *J. Soc. Chem. Ind.*, 1925, **44**, 507-511T. and 526T.

Cellulose (cotton yarn) can be completely converted into liquid and gaseous products by the action of hydrogen under high pressure and temperature conditions and in the presence of finely divided nickel. No appreciable reduction takes place under the conditions employed in the absence of nickel, though vanadium oxide and ferric vanadate appear to have some slight catalytic effect. —B.C.I.R.A.

The Chafing of Silk Fabrics. *Silk Jl.*, 1925, **2**, No. 15, p. 36.

Chafe marks on the surface of silk fabrics, particularly such as satins, where the silk is floated on the face, imply rough treatment at some stage of the manufacture, but it is frequently difficult to discover precisely where this occurs. A chafe on an otherwise clear surface may indicate that the wet fabric when in a bundle has been thrown in contact, perhaps only momentarily, with a rough box, floor, or bag. Folds and creases cause chafes which remain even after the fold has disappeared. Dark shades are more prone to chafes than mid or light. Every workman handling silk should be impressed with the necessity of using the utmost care to avoid undue friction in handling. The method of dyeing is said to have no influence on the production of chafes, but this may be considered doubtful. Wet silk is very easily chafed, and all excessive handling must be avoided. Chafes show up when the goods are perched for inspection. It should be remembered that these blemishes do not occur only in the dye bath. —F.G.P.

Chemical Studies in the Physiology of Apples IV. Investigations on the Pectic Constituents of Apples. M. H. Carré. *Annals of Botany*, 1925, **39**, 811-839.

A valuable summary is given of most of the important work done on "Pectins" and their hydrolysis products since the early discoveries of Braconnot; the confused state of the nomenclature of these substances receives some attention. Three classes of substances were systematically investigated in the researches on apple pectins here recorded—(1) Insoluble "Pectose," the complex of cellulose and "pectin" brought into solution by boiling with dilute acid. (2) This "pectin" and its partially demethylated derivatives, the "pectinic acids." These form the water-soluble extract from apple pulp. (3) The "insoluble" middle lamella pectic substance which is removed only by boiling with alkali after the acid treatment for (1). The completely demethylated pectinic acid is "pectic acid." All the pectic substances were determined as calcium pectate, a salt of definite composition. Variations of these different classes of pectic substance with the progress of ripening and senescence of apples are described, and the significance of the changes discussed. —L.I.R.A.

Protopectin (Pectose): Hydrolysis. M. H. Carré. *Biochem. J.*, 1925, **19**, 257-265.

Experiments described by the author indicate that Tutin's views on the non-existence of protopectin (or pectose) cannot be supported by experimental evidence. It is concluded, moreover, that pectose does actually exist as a practically insoluble constituent of the cell walls of apple tissue, and that it can be converted into the soluble modification known as pectin by the action of water and by dilute acids and alkalis, the nature of the change being probably hydrolytic. —B.C.I.R.A.

Hydrogen Ion: Estimation. F. A. Mason. *Bureau of Bio-technology*, 1925, **2**, 144-161.

A simple explanation of the meaning of hydrogen ion concentration and the significance of *p*H values is given. The essential efficiency of hydrogen ion methods as compared with older titration methods is emphasised. An indicator scale is given which covers the range of brewing operations. —B.C.I.R.A.

"Philanised" Cotton Fabrics. W. Kind. *Textilberichte*, 1925, **6**, 661.

When cotton fabrics are converted into wool-like materials by treatment with conc. HNO_3, a process known as "philanising," they suffer a loss of tensile strength in both warp and weft, and are rendered more susceptible to chemical attack by bleaching, dyeing, and printing. The loss is not always shown by tests on strips of fabric, since the latter shrinks during "philanising." The strength (corrected for shrinkage) of unbleached, bleached, dyed, and printed flannel fabrics after "philanising" were 101·1%, 52%, 59·1%, and 59·7% (calculated on the strength of the untreated fabric) respectively. —B.R.A.W. & W.I.

"Philanised" Fabrics: Strength. Philana A.-G. *Melliand's Textilberichte*, 1925, **6**, 662-663.

A reply to Kind (above). "Philanised" fabric should be regarded as an individual textile material rather than as a modification of

cotton fabric, and should therefore be judged as it stands, the evaluation including feel, shrinkage, and strength as a whole. Under these conditions "philanised" fabrics are stronger than the fabrics from which they are produced. —B.C.I.R.A.

Adhesive Substances; The Chemistry of——. G. M. Dyson. *Chemical Age*, 1925, **13**, 512-514.

Tests are described for measuring the strength of various adhesives, including glues, gums, and starches. —L.I.R.A.

Cotton, the Chemical Analysis of——; Identification of the Fatty Ingredients in Sized Goods. L. V. Lecomber and M. E. Probert. *J. Text. Inst.*, 1925, **16**, T345-351.

Sized Warps: Moisture Content. See Section 3B.

PATENTS

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

241,265. V. Vanderveld. Rebound-check mechanism for cloth measuring machine.

7—BUILDING AND POWER

(A)—CONSTRUCTION OF BUILDINGS

New Era in Mill Construction. *Amer. Silk Jl.*, 1925, **44**, No. 8, p. 61.

Of recent years much attention has been devoted to building construction of silk mills in America. Wider aisles between machines add to comfort and efficiency. Flat slabs of concrete make the building with lowest fire risk, and give the most rigidity and permanence with lowest maintenance cost. The old-fashioned habit of having numerous wide columns for support has given place to wide spacing and consequent improvement of light and convenience. Large window area and white paint have improved working conditions. Floors of maple give comfort, rigidity, and much less dust than concrete. Double windows for heat conservation in winter are being freely installed, as are air washing and humidifying plants. Individual motor drives give better quality and quantity. Except in weaving sheds, high-powered central lights are favoured. —F.G.P.

(B)—FIRE PREVENTION

Fireproofing: A New Fire Preventive Treatment. R. A. Kolliker. *Chem. Abstr.*, 1925, **19**, 3017 (from *Papier-fabr.*, 1925, **23**, 162-164).

The "Cellon" fire preventive treatment for paper and fibrous material is described. Cellon is a liquid, is non-toxic, odourless, water-soluble, and does not alter the physical properties of the sheet. —L.I.R.A.

(C)—POWER

Leather Belting: Application. R. F. Jones. *Text. World*, 1925, **68**, 2049-2053, 2797-2799.

Recent work carried out by the Leather Belting Exchange Foundation on certain leather belting problems is outlined. The work includes the following investigations —Arc of contact studies, the effect of centre distance on transmitting capacity, the effect of pulley size on transmitting capacity, the effect on the belt's capacity of using a small pulley to drive a large one and *vice-versa*, a study of the gravity idler such as the Lenix drive, and the effect of belt speeds up to 8,000 feet per minute on the transmitting capacity of leather belting. —B.C.I.R.A.

Textile Machinery: Power Consumption. F. S. Root. *Text. World*, 1925, **68**, 2789.

Data sheets showing the power required to operate baling presses and goods hoists are reproduced. —B.C.I.R.A.

Induction Motor Controls: Selection. M. Sampson. *Text. World*, 1925, **68**, 2787-2791.

A general discussion of the function of motor controls, various types of control apparatus, and the selection of types of control suited to the requirements of the individual classes of textile machinery. —B.C.I.R.A.

Gas Burners; Conditions Governing the Efficiency of——. S. W. Parr. *J. Ind. Eng. Chem.*, 1925, **17**, 1215-1216.

This paper points out the inherent inefficiency of the ordinary gas burners, where a large proportion of the air required for combustion is supplied as secondary air. The advantages and difficulties of increasing the primary air in gas burners of the Bunsen type are pointed out, and attention is called to the advantage, from the standpoint of combustion, of raising the pressure of the gas. —L.I.R.A.

Electromagnetic Loom Drive. See Section 3C.

(F)—LIGHTING

Lighting Code in Use in Germany. German Illuminating Engineering Society. *Sci. Abstr.*, 1925, **28B**, 457 (from *Illum. Eng.*, 1925, **18**, 96-97 and 130-132).

A series of recommendations for good practice in both interior and exterior lighting is detailed, drawn up by the German Illuminating Engineering Society. The matters dealt with include adequacy (a list of suitable degrees of illumination is given), diffusion of lighting, evenness and freedom from flicker, protection from glare (nearby sources to be screened if brighter than 4·2 candles per square inch), removal of products of combustion, general

appearance. The code of illumination values for exterior lighting is arranged according to traffic. The requirements of factories and workshops are dealt with, and the "adequate" illuminations for certain classes of work are scheduled. Practical hints are given on the general principles of illuminating engineering, for example, maintenance, measurements, screening, &c. The important recommendation is added that a lighting specification should be obtained for every installation *before* the lay-out of the wiring is arranged. Details to be considered in drawing up this specification are enumerated.
—B.C.I.R.A.

Illumination. P. W. Cobb and F. K. Moss. *Sci. Abstr.*, 1925, **28B**, 458 (from *J. Amer. Inst. Elec. Eng.*, 1925, **44**, 672-673).

A test designed to determine whether eye fatigue was increased at high illumination intensities is described. The test object consisted of a whitened disc with twelve black spots equally spaced at the periphery. The disc was mounted in front of a steady white background, having twelve similar black spots close to the edge of the disc. The disc was rotated at a given speed, and the subject was required to concentrate his attention on one of the spots on the disc and to press a key when this spot passed a certain spot on the background. The number of trials and number of successes were recorded automatically. It was found that the proportion of successes was practically the same at both of the brightnesses used, namely, 100 and 5 millilamberts. —B.C.I.R.A.

Lighting Dyehouse and Bleachery. A. K. Robertson. *Text. Colorist*, 1925, **47**, 90.

Many kinds of artificial light are mentioned, including gasoline torches, such as are used by road repairers, acetylene and mercury vapour lamps, the latter not in the dyehouse. There is considerable mention of the law that the intensity of light varies inversely as the square of the distance.
—F.G.P.

(I)—Ventilation

Works Ventilation: Modern Systems. C. L. Hubbard. *Dyer and Cal. Printer*, 1926, **55**, 54-56. (from *Textile World*).

Modern theories of ventilation pay little attention to the composition of air so far as it is affected by respiration, but are devoted to proper movement, temperature, and humidity control associated with the removal of dust, odours, and bacteria. Humidity is important; too dry an atmosphere affects the respiratory passages, and renders operatives liable to colds; and too humid an atmosphere (as in dyehouses) retards evaporation of perspiration, and thus interferes with the natural regulation of internal temperature of an operative. The practical conditions essential to the ventilation of textile works are discussed. —A.J.H.

8—DESIGN

Art in Silks. *Text. American*, 1925, **43**, No. 4, p. 11.

France in general and Lyons in particular has been for long years the centre of the production of the finest designs in silk. All the best American designs in the Louvre decorative art section are inspired by French masters, a source of great satisfaction to American designers. —F.G.P.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Hemp Industry for Western Canada. *Text. Rec.*, 1925, **43**, No. 512, p. 63.

Refers to attempts which have been made to establish a hemp industry in Western Canada. It is stated that the Prairie Provinces, which account for about 80% of the Canadian wheat crop, have no binder twine factories. The present prospects of establishing a hemp industry in Western Canada are considered to be very hopeful. An export trade in binder twine is already established, and there is every possibility of expansion when Canada is in a position to produce her own raw material. —L.I.R.A.

Advisory Committee on Silk Duties. *Silk Jl.*, 1925, **2**, No. 15, p. 57.

The names of the Committee include four members of the Manchester Chamber of Commerce, three members of the Cotton Spinners' and Manufacturers' Association, one of the Master Packers' Association, one of the Federation of Master Cotton Spinners' Association, four Customs officers, and none representing silk or rayon as such. Applications for inclusion by silk and other interests will be considered by the Committee. —F.G.P.

Silk Imports. *Silk Jl.*, 1925, **2**, No. 15, p. 58.

Considerable delay is being experienced at the Customs on parcels of silk goods imported from the Continent. At one port, the name of which is omitted, over 2,000 parcels were being held up at one time pending examination. These were all manufactured goods. Raw materials are said to be getting through reasonably fast. Rebates are working, it is stated, fairly smoothly, arrangements having been come to pending final decisions. The value of pure silk piece goods dyed and undyed rose from £6,315,282 for the first half of 1924 to £9,833,099 for the same period of 1925; silk mixture goods rose from £2,875,783 to £3,645,000, while silk ribbons declined from £1,231,931 to £594,767. It is interesting to note that the value of silk imports for June 1925, the month preceding the Customs tax, was £3,748,422 more than for June 1924.
—F.G.P.

Texas Technological College: Equipment. *Text. World*, 1925, **68**, 2314.

This new college has a 40 acre plot for cultivation tests, and a 2,000 acre farm where a student may take a one acre plot and cultivate it as he pleases. A long list is given of the machinery equipment in the opening, spinning, winding, sizing, weaving, bleaching, dyeing, finishing, and testing departments, including an oil spraying outfit in the blow-room.
—B.C.I.R.A.

Artificial Silk Production in Germany, 1911-1919. K. Königsberger. *Kunstseide*, 1925, **7**, 227-230.

A review of the position of the German artificial silk industry during the war. Certain statistics of exports and consumption are given; production on the one hand was curtailed by lack of solvents, &c., and normal consumption was diverted for war purposes. Out of seven firms operating in 1913 only the Bemberg and Glanzstoff works were able to continue working. —B.C.I.R.A.

Yarn Packages: Calculations. P. Beckers. *Melliand's Textilberichte*, 1925, **6**, 643-645.

It is shown how to calculate the length or weight of yarn, cross wound on tubes, which a box of given dimensions will contain, or, conversely, the size of box required to contain a known weight or length of yarn. —B.C.I.R.A.

Boll Weevil Control in U.S.A. (South Carolina). C. B. Nickels. *Exp. Sta. Rec.*, 1925, **52**, 857 (from *South Carolina Sta. Circ.*, No. 33, 1925, pp. 3-39, Figs. 8).

Calcium arsenate dusted on cotton resulted in an average extra profit of 29·85 dollars on six farms. Two calcium arsenate-molasses mixtures, in seven applications at weekly intervals, yielded no return. No profit was secured from the use of the Florida stripping method, and its application cost 1·54 dollars to the acre.
—B.C.I.R.A.

Weaving Shed Battery Hands; Employment of——. Textile Operating Executives of Georgia. *Cotton*, 1925, **89**, 1230.

Opinion is divided as to the advantage or disadvantage of employing battery hands in weaving sheds. Whilst the number of looms the weaver can tend may be doubled the battery hands may be responsible for much bad work chiefly owing to mixing the weft. —B.C.I.R.A.

Weavers; Selection of——. W. Spielman. *J. Text. Inst.*, 1925, **16**, 317-320.

Shirting Fabrics for the Indian Market. See Section 3G.

10—MISCELLANEOUS

Plastometer for Control Use with Dental Cream; A Simple——. E. Moness and P. M. Giesy. *J. Phys. Chem.*, 1925, **29**, 1282-1288.

The plasticity measurement is made by timing the flow of the plastic substance over successive intervals along a tube of uniform bore. To cause flow, the pressure of a mercury column of variable height is used, and the capillary tube is graduated in centimetres. Under these conditions data for a straight line curve showing mobility and yield shearing stress for the plastic substance may be obtained. When the plasticity value was very high, a slight effect due to increased resistance outside the curve was seen to occur with increased pressure. A diagram of a simple apparatus for plasticity determination is given. The authors show that the mathematical assumptions used in their method are not strictly correct, but errors therein are much less than those occurring experimentally. A simple viscometer is also described for standardising the capillary tube as regards radius. This viscometer differs from the Saybolt type in that—(1) The actual capillary to be calibrated is used. (2) Flow can take place at a constant head. —L.I.R.A.

Phenomena, Rapidly Varying; Some New Instruments for Recording——. W. G. Collins. (Paper given at a meeting of the Optical Society, Imperial College, 15th October 1925.) *Engineering*, 1925, **120**, 512.

In these instruments a fine stylus terminating in a highly polished spherical surface of small radius rests on a travelling strip of transparent celluloid. A record of the movement of the part of the instrument to which the stylus is fixed is obtained by the permanent deformation of the surface of the celluloid by the stylus. As this deformation is produced by very slight pressure, and no material is removed from the celluloid, the energy required to produce the record is very small. The depth of the trace is of the order of two to three microns and of proportional width. Thus only a comparatively small amount of celluloid film is required, and the record is immediately available for examination by optical methods. The device has been employed in several instruments, which have been designed and constructed for such purposes as measuring the vibrations in a travelling motor car or railway coach, determining the amplitude and characteristics of the vibrations set up in roads by the passage of various types of vehicles, recording rapid changes of stresses in materials or structures subject to varying loads, such as railway bridges, and for recording high-frequency variations in gas pressures, as in the cylinders of high-speed internal combustion engines.
—L.I.R.A.

Photoelectric Photometry. N. R. Campbell and E. G. New. *J. Scient. Instr.*, 1925, **3**, 2-6.

An account of the photometer used has been given in a previous paper. The modification in apparatus and experimental procedure are described in this paper. The main improvement is in the photoelectric cells. In the new type the current is much more nearly proportional to radiation than in the old. Light filters have been introduced, and a modified form of vacuum lamp filament supports has been adopted. Minor modifications of apparatus and the methods of making luminous flux measurements and electrical measurements are described. —L.I.R.A.

The Ashdown Rotoscope. *J. Scient. Instr.*, 1925, **3**, 15-20.

The apparatus is an improvement on older forms of stroboscope, a small rotating cylinder being employed instead of discs. The cylinder has two rectangular slots cut through it, in which are mounted thin plates, equally spaced, of breadth slightly less than the diameter of the cylinder. The distance apart of these shutter plates is $\frac{1}{8}$ in. for normal purposes, but depends on the definition required. Thus a very small angular movement is sufficient to shut off the view, while a large field of vision is allowed. The normal cylinder speed can be varied between 10 and 300 revs. per second. For great regularity, electric motor drive and mechanical governor are employed, but for the industrial model a clockwork motor and governor are used with a five-speed gear box. Speed can be continuously changed between the different ratios. Some of the applications and observations are described. These include ring spinning frames, gear and chain drives, &c. —L.I.R.A.

Textiles; Dictionary of—— (1924, New York). L. Harmuth. *Exp. Stat. Rec.*, 1925, **53**, No. 5, p. 412.

The dictionary includes terms and definitions referring to textiles and to the various materials used in the manufacturing and finishing processes. Under cotton a description is given of the fibre and its chemical properties, with a classification of commercial varieties and grades. Silk is discussed from the standpoint of preparation, chemical properties, classification, and history of the development of the silk industry. The information on wool includes physical and chemical properties of the fibre, classification of domestic, English, and other foreign wools, shrinkage tables for American and the more important foreign wools, the equivalents of American and international terms in spinning counts, and an explanation of international standard wool terms. —L.I.R.A.

Water Filter. E. Belani. *Kunstseide*, 1925, **7**, 233-236.

An improved form of Schröter water purification apparatus is described. The flow of water is caused by gravity action, and the filter is simple in construction. It is recommended for use in purifying water for general textile purposes, including the manufacture of artificial silk. —B.C.I.R.A.

Bacterial Actions: The Proteolytic Action of *Bacillus Granulobacter Pectinovorum* and its Effect on the Hydrogen-ion Concentration. W. H. Peterson, E. B. Fred, and B. P. Domogalla. *Exp. Sta. Rec.*, 1925, **53**, 106 (from *J. Amer. Chem. Soc.*, 1924, **46**, 2086-2090).

This contribution from the Wisconsin Experiment Station presents the results of a study of the proteolytic changes brought about in a 5% corn mash by the action of *B. granulobacter pectinovorum* with data on the H-ion concentration and titratable acidity of the medium, the determinations being made 12, 24, 48, and 96 hours after the inoculation. The data show rapid and continuous hydrolysis of the protein, the soluble nitrogen increasing at the rate of about 200 mg. per 100 gm. of corn in 24 hours. The increase was at first mainly in the form of protein or intermediate products, but after the first 24 hours the intermediate products increased more slowly and the amino acid and peptide nitrogen more rapidly. At the end of 96 hours most of the nitrogen was in the form of proteoses, peptones, and peptides. The figures for titratable acidity at the beginning and at each time period were as follows—0·2, 2·8, 4·4, and 1·8 cc. of N/10 acid in 10 cc. of mash. Corresponding figures for the H-ion concentration were pH.6, 4·4, 4·1, and 4·4. The latter figures show that the original corn possessed but little buffer action, but that with the formation of products of protein hydrolysis there was a considerable increase in buffer action. —L.J.R.A.

Waste Water of Dyeworks: Treatment. F. T. Ellis. *Dyer and Cal. Printer*, 1926, **55**, 32-33.

Methods for recovering fatty substances from waste liquors of dyeworks are described. —A.J.H.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Automatic Silkworm Rearing. *Silk Jl.*, 1925, **2**, No. 18, p. 49.

A revolution in sericulture involving a considerable reduction in costs is being investigated in Italy. Silkworms will be raised by machinery, the only labour needed being the overseers. The mulberry bushes will be trained to grow their branches straight, so that the leaves will be cut off by machinery and conveyed on bands to the worms, which are reared in isolated colonies in a level temperature. The leaves are delivered fresh, and the worms, at a given signal, transfer themselves to the new leaves, so that the old bedding may be removed. Rearing will go on for 4-5 months or longer, and the trees will be trained to produce the leaves as required. The newly hatched worms move along endless bands, crawling on to quicker ones as they grow up, and when ripe meet twigs, where they spin. The cocoons are automatically picked off and transported to the drying plant. —F.G.P.

Tussah Silk Production in Fengtien. *Silk Jl.*, 1925, **2**, No. 18, p. 59.

The industry is rapidly increasing, the statistics are given in pieces and Fengtien dollars. About 50% of the crop is sent to the Antung filatures and 40% to Chefu. There are 60 filatures in Antung, each with 200-500 reels, and some employing 600-700 people. The best raw silk goes to America, seconds to England and France, the rest to Japan. The Japanese export their pongee to America. The Chinese production of tussah fabrics consumes only 10% of the crop. The waste is exported, manufactured into silk/wool fabrics, and sent back to China. More statistics are given in Shanghai taels and piculs.

—F.G.P.

(C)—Vegetable

Prevention of Insect Attack on Stored Grain. W. W. Mackie. *Exp. Sta. Rec.*, 1925, **53**, 52 (from *California Sta. Circ.*, No. 282, 1925).

The author found that copper carbonate dust applied at the rate of 2 oz. per bushel effectively protected wheat against insect attack. —L.I.R.A.

Cell Wall: Dye Absorption. F. Schwarz. *Bot. Zentr.*, 1925, **148**, 194 (from *Ber. Dtsch. Bot. Ges.* (Generalvers. Heft), 1924, **42**, 21 and 38).

In cellulose walls dye is deposited in particles of the largest size, in lignin walls in medium sized particles, and in cutin walls in the smallest sized particles. Dye adsorption is greatly dependent on the swelling properties and the degree of hardening of the cell wall. The adsorptive power of a cell wall is a safe means of judging of its nature. The specific actions of the two most important dyes are described, and the paper concludes with an account of the dyeing methods employed.

—B.C.I.R.A.

The Non-Cellulosic Constituents of Wood. A. Foulon. *Chem. Abstr.*, 1925, **19**, 3014 (from *Zellstoff. u. Papier*, 1925, **5**, 212-213).

Wood meal after extraction with benzene is subjected to a mild hydrolysis with 85% acetic acid solution containing 0·3% sulphuric acid (Ger. Patent 309,551), by which the ligneous substances are separated from the cellulose almost quantitatively. By the combined methods of Cross and Bevan and Koenig, the cellulose content of spruce wood is determined as 50·5%. The period of maximum hydrolysis is reached after 27 hours, and 27% dissolves. The soluble substances are chiefly carbohydrates consisting of pentoses and hexoses in the ratio 1 : 2. Evaporation of the acetic acid extract yielded on the addition of water an amorphous high molecular substance termed "xylogen," which contains hexoses combined with a phenol complex. Extraction tests showed 2-3% phenol in wood. Xylogen contains 63·97-64·20% C., 6·08% H; is soluble in formic acid, acetic acid, and propionic acid; is precipitated in part by carbon dioxide from alkaline solutions; and is separated into the following fractions—(1) 4% extract with sodium bicarbonate solution, (2) 12% soluble in benzene, (3) 44% soluble in chloroform, and (4) 40% soluble in glacial acetic acid. —L.I.R.A.

The Lignin Problem. K. G. Jonas. *Chem. Abstr.*, 1925, **19**, 3014-3015 (from *Wochbl. Papierfabr.*, 1925, 56, S.N. 83-86).

The present status of the lignin problem, limited to coniferous woods, is critically discussed. Methods of determining lignin which yield little or no change in its original composition should be employed, and for this purpose the procedure of Willstatter and Zeichmeister is recommended. Lignin contains no chemically bound carbohydrate constituents, and is defined as a wood substance without sugar. Prolonged treatment with concentrated hydrochloric acid probably leads to an association or polymerisation process. The dark appearance of Willstatter lignin is probably due to the formation of a CO group which subsequently enters into reaction. This does not occur

in the sulphite pulp process. The determination of lignin by chlorine or chlorine dioxide yields high results, and the composition of the material is altered. Its aromatic nature has not been clearly shown; the methods of alkali fusion, pressure oxidation, or destructive distillation are too drastic and unsatisfactory. Klason's evidence is regarded as incomplete. Lignin, like cellulose, is considered as a product of assimilation processes of the plant, and is formed indirectly from the soluble carbohydrates present. —L.I.R.A.

Lignin in Wood; Distribution of——. Microscopical Study of Changes in Wood Structure upon Subjection to Standard Methods of Isolating Cellulose and Lignin. G. J. Ritter. *J. Ind. Eng. Chem.*, 1925, **17**, 1194-1197.

By aid of the microscope in following the chemical reactions, it appeared qualitatively that the lignin in wood is located in the middle lamella as well as in the other layers of the cell wall. The method employed indicates that approximately 75% of the lignin is located in the middle lamella and 25% in the other layers of the cell wall. The author suggests that the claim that the middle lamella is composed chiefly of pectin or calcium pectate seems poorly founded. The lignin of the middle lamella shows structural form, the cell wall lignin an amorphous character. Chemically isolated lignin has been separated by mechanical means into two forms of different chemical composition, and the location of these two forms has been determined in the wood structure.

—L.I.R.A.

Weed Eradication in Flax by Chemicals. L. Ritter. *Exp. Sta. Rec.*, 1925, **53**, 235, through *Textilberichte*, 1925, **6**, 121 (from *Spinner und Weber*, 1924, No. 70, pp. 1-4).

In experiments at the University of Giessen wherein copper sulphate, iron sulphate, kainit dust, and lime nitrogen were used, flax withstood iron sulphate the best. This chemical was also the safest in damp years. Lime nitrogen injured the flax as much as the weeds, and copper sulphate damaged the weeds very little. Kainit dust destroyed the weeds in dry weather or else retarded their development.

—L.I.R.A.

Australian Cotton: Grading and Ginning. *The Australian Cotton Grower, Farmer, and Dairyman*, 1925, **1**, No. 8, pp. ii. and 1.

The New South Wales Crop for 1924-25 was guaranteed in respect of prices by the New South Wales Government, the guarantee lasting from 24th March to 16th August 1925. Queensland cotton is guaranteed by the British Australian Cotton Association, Limited. All the latter crop is ginned at Whinstanes, Rockhampton (Glenmore), Gladstone, and Brisbane; and all Durango, wherever grown, is ginned at Gladstone. Details of price and regulations are given. —B.C.I.R.A.

Cotton Cultivation in Queensland. J. D. Young. *The Australian Cotton Grower, Farmer, and Dairyman*, 1925, **1**, No. 8, pp. 3-6.

Suitable rotations for Queensland dry land and moist coast land cotton farming are discussed. —B.C.I.R.A.

Durango Cotton Cultivation in Queensland. *The Australian Cotton Grower, Farmer, and Dairyman*, 1925, **1**, No. 8, p. 10.

Durango in the Eidsvold district yielded heavily on the flats, but on the scrub, owing to the rich nature of the soil, the growth of the plants was as much as 7 to 8 feet high,with flowers in abundance. The dryness of February and the sharp frost in April did much damage to this overgrown cotton, and the old variety of seed was found to do much better on this type of land. In the Guluguba district also there were complaints about Durango, where it was found to be a dry yielder and not as drought resisting as the ordinary cotton. It is consequently suggested that though the coastal and northern districts may be suited to this variety, the Downs and the Western Districts are altogether unsuitable. Durango is the only pure variety of which the Agricultural Department has any large quantity of seed available, and growers are advised to plant this seed until seed of the new types, which are being tested, is available. It has given the most promising results over large sections of the State, and in the few instances where it is reported to have done poorly there are indications that the cause has been due to unfavourable weather conditions, rather than to any inherent fault in the seed. Durango produces a longer and much more valuable staple than the ordinary mixed seed. —B.C.I.R.A.

Cotton Pest in Trinidad. C. L. Withycombe. *Tropical Agric.*, 1925, 2, 286-287.

Sacadodes pyralis, a moth closely related to the Sudan boll worm, was described as a new genus and species by Dyar in 1912. The moth lays its eggs singly on the leaves, bolls, stems, &c., of the cotton plant, but most commonly at the bases of the bolls where protected by the bracts. The caterpillar, on hatching, makes its way at once to a boll or flower bud, and commences to bore into and feed on the interior. The larva becomes full grown in the course of a few weeks. The mature larva makes its way out of the cotton boll and down to the ground, where it pupates at or near the surface. The adult moth excapes in from two to three weeks. A further study of the insect is required before effective control measures can be initiated.

—B.C.I.R.A.

Native British Guiana Cottons. *Tropical Agric.*, 1925, **2**, 273-274.

An extract from a book on British Guiana, published in 1866. In 1828-1829 Hillhouse collected from the interior of British Guiana seeds of the following varieties unknown to that date—Aoyuama, Comacka, Comacka-Seero, Iffetackaasery, Ebeeseboora, Coodebeyoey, Etoory, Steygur, Cooreeteca, Murry-murry-sereo, the hard Comacka, and the Silver Seed, these being nearly the whole of the indigenous varieties. Seven of these varieties are described.

—B.C.I.R.A.

Cotton Pyralids in French West Africa. P. Vayssière and J. Mimeur. *L'Avenir Text.*, 1925, **7**, 474-477 and 533-538.

The only Pyralids attacking the leaves of cotton in French West Africa are *Cylepta derogata* and *Margaronia* (*Glyphodes*) *indica*. The last-named appears to be of relatively little importance, and in the French Sudan rarely occurs on cotton. The eggs are laid on the leaves, where pupation also occurs. The larval stage lasts about 16 days and the pupal stage about 11 days. Reproduction continues throughout the year. It could no doubt be controlled on cotton by arsenical sprays should occasion arise. *Sylepta derogata* feeds on various plants; in the French Sudan it has only been found on *Hibiscus esculentus*, *Abelmoschus moschatus*, and both indigenous and imported cotton. The lengths of the various stages are 5-10, 16-29, and 8-10 days for the egg, larva, and pupa. There are probably five generations annually. Hibernation occurs in the larval stage in the soil, the emergence of the adults depending on atmospheric humidity. The eggs are laid in groups on both sides of the leaves, particularly on the upper surface. Indigenous cotton recovers from attack by producing fresh foliage, but imported varieties dry up and die off. Clean cultivation and the collection and destruction of larval and alternate food plants are the most important remedial measures. *Hibiscus* may be grown as a trap crop for the first generations, but should be destroyed as soon as the cotton plants appear. Various new parasites and hyperparasites of *S. derogata* are described.

—B.C.I.R.A.

Pink Boll Worm Attack: Seasonal Variation in Egypt during 1916-1924. C. B. Williams, *Min. of Agr., Egypt, Tech. and Sci. Serv. Bull.*, No. 67, 1926.

Full records are given of counts of the number of green bolls attacked by pink boll worms in Lower Egypt. Taking the mean dates for the period 1916-24, 25% of the bolls were attacked by 16th-17th August, 50% by 1st-2nd September, and 75% by 14th-15th September. In different years these percentages were reached at slightly differing dates, the variation giving a measure of earliness or lateness of boll worm attack. Comparison with all available records of earliness or lateness of the crop shows that from 1919 to 1924, at least, the date of boll worm attack varied with the condition of advancement or retardation of the crop. That is to say, the boll worm attack has always reached the same stage when the crop has reached the same state of maturity. The total amount of infestation has remained approximately constant during the period under consideration. Evidence is given to show that the incidence of boll worm attack is decided by the state of the cotton crop, and is not directly influenced by climate.

—R.W.M.

Cotton Cultivation in Brazil. A. Seyrig. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 563-565.

Shortage of labour is the great drawback to the cultivation of cotton in Brazil. The Brazilian Government has formulated a scheme by which foreign immigrants are induced to form a class of small proprietors cultivating their own fields or with the help of only a few labourers.

—B.C.I.R.A.

Plant Cuticle; Study of——. B. Lee. *Ann. Bot.*, 1925, **39**, 755-768.

Cutin and suberin, although generally similar, show many differences; notably in the absence from cutin of phellonic acid and glycerol. Cutin is a complex mixture of (1) fatty acids both free and combined with alcohols that have undergone condensation and oxidation; (2) soaps of fatty acids; (3) unsaponifiable material which probably contains some higher alcohols; (4) resinous substances; and (5) a compound giving tannin reactions. The relative quantities of unsaponifiable material vary, but there is always a higher total quantity of hydroxy-fatty acids than of normal fatty acids. The preponderance of hydroxy-fatty acids is the result of oxidation processes taking place during the deposition of the cuticle. The authors isolated from the fat of the cuticle of chrysanthemum petals a substance resembling some of the alcohols isolated in the B.C.I.R.A. laboratories from a benzene extract of American cotton.

—B.C.I.R.A.

Germination and Subsequent Growth; The Relation Between the Rate of——: Physiological Pre-determination Experiments with Certain Economic Crops. M. A. H. Tincker. *Ann. App. Biol.*, 1925, **12**, 440-471.

The experiments described were directed to determine the effect of the condition of seed on its subsequent growth as a plant. With oats, for instance, increased vigour of germination and subsequent growth were obtained by artificially altering the maturity of the seed by drying. Soaking in water was also found to have a similar

effect, not only with oats but also with several species of grasses, but the results with leguminous seeds varied with different species. There is apparently a definite correlation between the vigour of germination and the rate of subsequent growth. —L.I.R.A.

Flax in Iraq. *Bull. Imp. Inst.*, 1925, **23**, 481-482 (from *Report of the Administration of Iraq for the period* 1923. *April-December* 1924, *Colonial* No. 13).

Experiments have been carried out in Iraq by the Department of Agriculture to determine the suitability of the country for flax production. The last two seasons' work has proved definitely that flax can be grown and prepared in the country of a quality which would be saleable at a good price in the United Kingdom. The Department is now in a position to give advice regarding the cultivation of flax and the most suitable varieties to grow. The development of a flax-growing industry is hindered by the absence of a mill to purchase the straw from the growers, and by the fact that commercial bodies are not disposed to establish mills until they are assured of a regular supply. Any undertaking commencing flax operations in Iraq would have to incur considerable expense in stimulating the cultivation of the crop, and it would therefore be necessary for some sort of limited concession to be given. This question is under the consideration of the Government.

—L.I.R.A.

Cotton Cultivation in Tanganyika. R. C. Wood and T. McEwen. Empire Cotton Growing Corporation, *Reports from Expt. Stations*, 1923-1925 (London 1925), pp. 10-27.

Trials at Mpanganya for the year 1924 showed deep cultivation on light land to yield no better results than the ordinary native shallow cultivation. Cage experiments proved the cotton bug (*Dysdercus*) and the dusky bug (*Oxycaroenus*) as responsible for much of the stained cotton either directly or by introducing fungi. Spacing and single plant selections from 1922-1924 are also discussed. "Salsbury" is used as a standard for uniformity and consistency. It has nearly white pollen grains, and as practically all of the Mpanganya selections have yellow pollen, a wide departure from the original American stock is indicated. Spacing, time of sowing, and spinning test results are also given. —B.C.I.R.A.

Jassid-Resistant Cotton Breeding, South Africa. F. R. Parnell. Empire Cotton Growing Corporation, *Reports from Expt. Stations*, 1923-1925 (London 1925), pp. 5-9.

The low cotton veld extending through the Eastern Transvaal into Zululand suffers from serious jassid infestation; and the wet years are the worst years. Trials on a number of varieties for jassid resistance during the last year yield the following results—Cambodia introduced from India is completely immune. The boll is large, and many plants yield over $1\frac{1}{8}$ in. staple, but its growth habit makes it of doubtful value as a field crop. Some of the plants reach 8 to 9 feet in height, and almost as much in diameter; and the stems are rather weak and delicate, making it subject to damage by wind. It is hoped to import less vigorous strains from India for trial next season. A Zululand hybrid strain Z_1 shows a high degree of resistance, but yields only a fair number of bolls per plant. Bancroft selections, on the whole, appear to be most promising, as they are of better habit and carry a larger boll than those from Zululand Hybrid. —B.C.I.R.A.

Cotton Production in Queensland. G. Evans. *Empire Cotton Growing Review*, 1925, **2**, 169-183.

Queensland cotton growing history is briefly reviewed, and some details of the course of the crop during the seasons since 1921 are given. The range of conditions in the cotton belt is extremely wide, and the lack of homogeneity in the soils of the localities is particularly striking. Cotton growing instruction is difficult, for the exact cultural details have to be worked out in each separate area. Farmers are therefore encouraged to assist by conducting experiments themselves. The local soil and general environmental differences also result in distinct differences in the raw cotton produced, even when the same variety is planted. "Hill" cotton is thus of different character from that grown on adjacent alluvial flats.

Durango after three or four years is showing signs of new place effects. Slight variations are observable in the character of the staple, the habit of growth, earliness and other factors. Straight selections have been made, and it is hoped to evolve from them even better types than the already successful general type. As no one variety is expected to meet the requirements of the whole of Queensland, other varieties, such as Acala, Lone Star, and Webber 49 are under trial.

The Government policy is to encourage the production of the highest quality cotton. A staple of at least full $1\frac{1}{8}$ in. to $1\frac{1}{4}$ in., and if possible averaging $1\frac{3}{16}$ is sought. In the times of low prices for this type of cotton it is hoped always to secure an average premium of 300 points. However, the maintenance of high quality cotton production is dependent on high quality cultivations, and an all-round improvement in this respect is required if yield and quality are to be maintained.

There is little hope for cotton growing on the plantation scale in Queensland, on account of labour supply; and the individual growers are urged to restrict their

acreage to an area within their capacity to cultivate thoroughly. High yield of good quality cotton per acre should be the aim.
—B.C.I.R.A.

Cotton Cultivation in Nigeria. P. H. Lamb. *Empire Cotton Growing Review*, 1925, **2**, 184-197.

An authoritative account is given of the history of cotton growing and of the activities of the British Cotton Growing Association during the past twenty years, especially the introduction of Allen long staple cotton. Agro-economic difficulties and the competition from millet and ground nut crops are fully explained, and it is shown how the latter factor restricts developments in certain areas.
—B.C.I.R.A.

Sea Island Cotton Cultivation in St. Vincent. L. H. Burd. *Empire Cotton Growing Review*, 1925, **2**, 225-236.

Lint Length and Rainfall.—Variations in the maximum lint length of a pure strain of cotton may be ascribed to variations in environment, and those changes which occur from day to day may be regarded as due to changes in the climatic conditions. The critical period in determining lint length was found in Egypt and St. Kitts about nineteen days after flowering, and in the latter heavy rainfall during the critical period was found to increase the length of the lint. This latter result is the converse to the effect of heavy rains in St. Vincent, where as much as a 3·7 mm. reduction in staple length was observed. The explanation lies in the fact that the average 45 in. of rainfall in St. Kitts is on the short side for Sea Island cotton, and a relatively heavy rainfall produces an improvement in conditions. In St. Vincent, with an average rainfall of 100 in., the water supply is seldom deficient, and the conditions are normally humid. The periods of heaviest rainfall produce water-logged soils and other adverse effects, to the consequent depreciation of the lint length. If the cause and the depreciation prove general, it should be possible to predict the depreciation in lint length by about thirty days, and thus to facilitate grading.

Spacing Experiments.—Optimum spacing appears to be 17 in. at one plant per hole, 19 in. with two plants a hole, and at 18 in. it appears to be immaterial whether one or two plants are left in each hole. At all spacings wider than 19 in. the two per hole series gave a greater yield, and the wider the spacing the greater the superiority. As the superiority of the two per hole series is greater the earlier in the season the comparison is made, where there is any danger of a loss of bolls at the end of the season it would be wisest to leave two plants to each hole. Below 16 in. spacing the yield is reduced.

The Marginal Effect in Plot Experiments.—The results derived from the spacing experiments show marginal effects, which are dependent on the maximum root range of the plant. From these results it was calculated that the lateral range of the roots should extend to 6 or 7 feet; and this was verified by actual measurement. The exclusion of only the outside plants, in plot experiments on Sea Island, is therefore inadequate for the exclusion of marginal errors. All plants nearer to the margin than 7 feet should be discarded.
—B.C.I.R.A.

Cotton Insect Pests: Occurrence in Queensland. E. Ballard. *Empire Cotton Growing Review*, 1925, **2**, 237-240.

A report on the occurrence and severity of insect pests in general attacking cotton in Queensland up to 18th December 1924.
—B.C.I.R.A.

Cotton Seed Propagation. W. L. Balls. *Empire Cotton Growing Review*, 1925, **2**, 241-244.

A method of "sand sowing" applicable to direct sowing in the field is described, whereby 70 to 90 per cent. of successful plants may be derived from a limited number of valuable seeds. The seed is steeped; at the desired plant distances the soil is broken up by means of a hoe; a second man dibbles the seed, and a third waters and fills the hole with sand.
—B.C.I.R.A.

Red Leaf Cotton Seed Propagation in Egypt. T. Trought. *Empire Cotton Growing Review*, 1925, **2**, 245.

The precautions necessary in making use of the Red Leaf variety, to assist the germination of valuable seed sown one seed per hole, are emphasised. As Red Leaf seed is fuzzy, it germinates more slowly than Egyptian seed, and therefore requires soaking. It is also essential that the Red Leaf seed should be pure, and that the propagation plot of Red Leaf should be carefully rogued. —B.C.I.R.A.

Sudan Soil Alkali: Effects. A. F. Joseph. *J. Agric. Sci.*, 1925, **15**, 407-419.

The cotton growing area in the Gezira consists of a heavy clay soil, the proportion of clay being about 50%-60% in the upper layers with a maximum at about the fourth foot. The water-soluble salts amount to about 0·2%. The proportion is highest at about the third to fifth foot. The alkalinity is highest at the second foot. In the first two feet the salts consist mainly of sodium carbonate, and the third and fourth of sodium sulphate. Judged by its chemical composition, the Blue Nile irrigation water is excellent, but when concentrated by evaporation to the extent it usually reaches at the end of the irrigation cycle, it contains a very high proportion of alkali salts. It is estimated that a season of normal irrigation would cause an increase of 0·01% in the alkali content of

the first four feet of soil. The sodium salts can readily act on the clay, and the sodium clay so formed hydrolyses with the formation of sodium carbonate. Samples taken at the same time from good and bad plots in the same area show a strong correlation between salt content and crop yielding power. There is also a correlation between *p*H and fertility. In the same season and in the same area unirrigated plots give a higher yield than those which have been previously under the same system of cultivation. —B.C.I.R.A.

Modern Ideas about Cotton. A. J. Hall. *Dyer and Calico Printer*, 1926, **55**, 66-67.

The first of a short series of articles on the physical and chemical properties of cotton. The growth within the boll, formation of striations and convolutions, cross sections and influence of wall thickness on dyeing properties of cotton fibres is described. —A.J.H.

The Pectin Content of Flax Fibre. Wm. Honneyman. *J. Text. Inst.*, 1925, **16**, T370-374.

(D)—Artificial

Sniafil Fibre: Properties. *Text. Mercury*, 1925, **73**, 432.

Snia Viscosa, the Italian artificial silk producers, have recently put on the market a new fibre by the name of "Sniafil." It is a staple fibre having as its base the same raw materials as viscose, but treated differently, chemically and mechanically. Instead of being delivered in a continuous length it is delivered in the length required by the user. It has been favourably received alike by cotton and woollen manufacturers. The product is stated to have extraordinarily good spinning qualities, particularly with wool, because of its close similarity in physical characteristics. Sniafil has no lustre and in yarn and fabric cannot be detected from wool. It can also be spun without any other fibre. There are two qualities—F.L. (filatura lana) for wool spinning and F.C. (filatura cotone) for cotton spinning mills. It is recommended that when using Sniafil, 10% of wool should be added to prevent a loss of tensile strength in the wet condition. —B.C.I.R.A.

Artificial Silk Centrifugal Spinning Mechanism. C. Schmitz. *Melliand's Textilberichte*, 1925, **6**, 732-733.

A centrifugal device for spinning artificial silk has the lower spindle, which is rotated by worm gear mechanism, so connected with the upper spindle which carries the pot, that the pot, when filled, can be braked by hand and removed without stopping the machine. —B.C.I.R.A.

Viscose Solution: Ageing. R. O. Herzog. *Kunstseide*, 1925, **7**, 261-262.

The author criticises Bernhardt's paper on the ageing of viscose solution, and defends the theory that dispersivity decreases with age on the evidence afforded by extremely careful measurements of actual particle size at different stages, by micro-diffusion results and by the results obtained by very sensitive chemical reactions. —B.C.I.R.A.

Cellulose: Action of Sodium Hydroxide. J. D'Ans and A. Jäger. *Kunstseide*, 1925, **7**, 252-256.

A continuation of the authors' work on the action of sodium hydroxide on different forms of cellulose. The cellulose material of the present article is paper board, used sometimes for viscose manufacture, and the results indicate maximum swelling at a sodium hydroxide concentration of 12% (volume %). Tables and curves representing the swelling of bleached and unbleached sulphite cellulose at varying concentrations of sodium (and potassium) hydroxides are given. Experimental results are also given which show very clearly the lowering of the swelling effect brought about by the addition of hydrochloric acid, salts, and various neutral substances, including alcohol, tannin, sugar, and gelatine. By a cooling curve method the authors sought to measure the heat developed in the ageing of soda-cellulose; they arrived at a value of 0·417 cals per hour per gram of soda-cellulose. The heat of wetting of cellulose with a moisture content of 6% with water was found in a preliminary experiment to be 2·6 cals per gram of cellulose and, with 17% sodium hydroxide solution, 24 cals per gram. —B.C.I.R.A.

Artificial Silk: Manufacture and Weaving. A. B. Shearer. *Text. Mercury*, 1925, **73**, 538-540.

A report of a lecture in which the manufacture of viscose silk is briefly dealt with and the use of artificial silk in weaving is discussed. —B.C.I.R.A.

X-Ray Structure of Cellulose. See Section Ic.

Patents

Artificial Silk Spinning Device. Siemens-Schuckertwerke Ges., Siemensstadt, Berlin. E.P.241,948.

The pumps associated with each of the spinning nozzles of an artificial silk, &c., plant are dispensed with, and the liquid to be spun is supplied to the spinning nozzle or nozzles from an hydraulic accumulator intermediately through a throttling device such as a cock or a perforated plate having a relatively small passage through it. Normally there is a substantial fall of pressure beyond the throttling device, but should the nozzle become obstructed the pressure immediately rises, obviating choking. The accumulator may consist of a cylinder in which a weighted piston

moves, and there may be interposed between the piston and the liquid to be spun a layer of liquid of lower specific gravity or of a neutral gas supplied as necessary by a pump; alternatively, a centrifugal pump may be used as the hydraulic accumulator. Liquid may be supplied to the accumulator either by a pump or by means of an auxiliary container intermittently filled and emptied. A filtering device of small resistance may be placed in front of the throttling device. A suitable construction of the latter consists of a grooved glass plate having a fine slot, and across which a slide can be moved.

—B.C.I.R.A.

Viscose Filaments: Preparation. H. Hawlik, Gneisenaustrasse, Berlin. E.P. 242,242.

A soluble sulphide is incorporated with or formed in viscose to be used for the manufacture of filaments, films, &c. By such addition the filament is protected, on coagulation, by the deposition of sulphur or metal sulphide on the surface of and within the filament. The objectionable formation of hydrogen sulphide is reduced, and the dyeing properties of the filament are varied. Suitable sulphides are alkali metal and ammonium sulphides, and those of arsenic, antimony, and tin. The alkali sulphides may be used for the solution of the xanthate. Several alternative methods of application are noted. —B.C.I.R.A.

Viscose Filaments: Manufacture. Viskose A.-G., Arnstadt, Thuringia, Germany. E.P. 242,993.

Artificial silk, &c., prepared from viscose, after the initial winding on bobbins and with or without washing to remove the remnants of the acid coagulating bath, is withdrawn from the bobbins, passed through a desulphurising bath, preferably of a warm solution of sodium hydroxide, led through a weak acid bath, and is finally rewound on a winding device running in washing water. —B.C.I.R.A.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Forkin Soft Waste Cleaner. *Text. Rec.*, 1925, **43**, No. 512, p. 49.

The machine is of the double roller type. The waste material can be fed direct to a travelling lattice by hand or into a hopper feeder and thence to the machine. Either a dish feed or a pair of feed rollers can be employed. From either the material is caught by a rapidly moving toothed roller, covered with Garnett wire, from which it is combed off and presented to a second similar roller running at a higher speed. Air currents, induced by an exhaust fan, suck the material from the second roller and draw it on to a perforated cage. Subsequently the material can be taken off in a form similar to a scutcher lap, fed forwarded in fleecy form, or taken away through pneumatic trucks. The cotton is delivered in a well-opened, fleecy state.

—B.C.I.R.A.

Cotton Combing Machinery. W. J. Ellison. *Text. Manufacturer*, Jubilee Number, 1925, 27-31.

An account of the development of cotton combing machinery in the last 50 years.

—B.C.I.R.A.

Cotton Opening Machinery. H. Wilkinson. *Text. Manufacturer*, Jubilee Number, 1925, 17-25.

A general review of fifty years' progress in cotton opening machinery.

—B.C.I.R.A.

Hackling Machines; Improvements in——. *Text. Mfr.*, 1925, **51**, No. 612, pp. 419-420.

The irregularity of the hackling treatment due to the defects of existing hackling machines is discussed. Two recent improvements protected by Fairbairn, Lawson, Combe, Barbour, Ltd., are then described. The first is the addition of a differential motion to the sheet drive whereby the speed of the sheets is increased during the lowering and decreased during the raising of the flax, so that the speed of the pins is kept constant relative to the flax through which they are passing. The second improvement is the adoption of a minimum grouping of pins and staggering of the pitch of the pins, so that the whole breadth of the flax is traversed with the passage of the fewest number of bars during the dwell, and each succeeding series of groups splits the spaces left by the preceding series. —L.I.R.A.

(B)—Spinning and Doubling

High Draft Mechanism. F. Engelmann. *Leipziger. Monats.*, 1925, **40**, 11-14, and 50-54.

A further article supplementing a previous paper. The disadvantage of the described mechanism in which the plane of the drafting field is broken is that it is of maximum value only for long staple cotton. The arrangement becomes of general application if an endless leather band is introduced round the front and middle bottom rollers and a tension roller. By this means the distance between the foremost pairs of rollers may be reduced to 14-15 mms. This is said to be the most satisfactory system yet devised.

—B.C.I.R.A.

Silk Waste Spinning. *Silk Jl.*, 1925, **2**, No. 18, p. 39.

Schapping is a process of fermentation whereby silk waste is rid of part of its sericin. It is more efficiently done on the Continent than in England, 15%-20%

being removed. The old process was to pile a heap of waste in a warm, damp place, and turn it over for several days; the modern method is to fill a cage in a 6 feet square tank with well beaten-down waste, and keep it soaked in water at 140° F. for six days. During this time a few rough samples are taken, and when it shows fine fibres that part of the treatment is complete. The silk is whizzed and washed in hot water, and then beaten in tanks of water at 180° F. Much skilled supervision is necessary. A good schappe contains 2½%-5% of gum. The silk is carefully dried and bleached, and then all foreign matter picked out. After conditioning it passes to the opening machine, and the carder to lay the fibres straight. The mass is cut off the drum, and stripped to form a fleece, which is filled and combed. The fibre is then taken off in a book-board, and put in the press of the flat dressing frame. After dressing and combing, the required number of times, the silk is passed through the spreaders and fallers, and lapped and relapped until it is ready for the drawing heads, and the sliver is then sent to the roving frame. Silk is spun on dry frames. —F.G.P.

Mule Receding Motion. F. Metcalfe. *Text. Mfr.*, 1925, **51**, 368-369.

The object of the mule receding motion is to deliver a small portion of roving at a time when extra twist is being inserted into the yarn to counteract the contraction set up thereby. General details of the motion are given. —B.C.I.R.A.

"Spenhow" Mule Spindle Bolster. Spenhow Valve Co. Ltd. *Text. Mfr.*, 1925, **51**, 421.

The new bolster comprises a cylindrical bearing for the spindle which is integral with two projecting arms, one of which is formed with a trough-like channel furnished with a hole through which the spindle is oiled, whilst the other is firmly screwed to the carriage to hold the bolster in position. The makers claim that there is no splashing of oil from the spindles on to the spinners' overalls or clothing. A further advantage is that the spindles can be oiled while the mule is running and uniform lubricating is assured for all the spindles. The use of this bolster is said to save at least 50% of the spindle oil, there is no fouling of the spindles, and the elimination of oil-stained weft saves trouble and loss in later bleaching operations. —B.C.I.R.A.

Doffers for Flyer and Cap Frames; Mechanical——. J. Dumville and S. Kershaw. *Text. Mfr.*, December 1925. Jubilee Number, 1875-1925, pp. 131-135.

Doffers which have been introduced into the woollen and worsted industries are dealt with in this article. The great advantages of mechanical over hand doffing are mentioned and a brief account is given of the main features of each of the better known mechanisms at present in use. —L.I.R.A.

Mule-spinning Machinery. T. Thornley. *Text. Mfr.*, Jubilee Number, 1925, 49-59.

Some improvements which have been made in mule spinning machinery during the last 50 years are detailed. —B.C.I.R.A.

Ring Spinning Machinery. W. A. Walsh. *Text. Mfr.*, Jubilee Number, 1925, 33-40, 45-47.

The author traces the development of ring spinning machinery during the last 50 years. —B.C.I.R.A.

Spinning Data for Sea Island Cotton. See Section Ic.

Spinning Tests for Uganda Cotton. See Section 6.

(C)—Subsequent Processes

Hosiery Yarns: Folding. *Text. Rec.*, 1925, **43**, No. 512, 75, and No. 513, 81.

The general principles underlying the design of stop motion twisters for folding hosiery yarns are discussed. In selecting a frame special attention should be devoted to the "pitch" or distance between the spindles; if this is too narrow there is danger of the threads running into each other and breaking down during ballooning. Also, owing to the large number of parts in connection with the cylinder which controls the driving bands, difficulty is experienced in fitting these on narrow-pitched frames. —B.C.I.R.A.

Yarn Gassing Frame. Arundel, Coulthard and Co. Ltd. *Text. Merc.*, 1925, **73**, 372-373.

The machine embodies many new features. The exhaustion of the gases is downwards and the ventilating pipes are all placed in the bottom of the framing. The machine can thus be built lower so that every part is readily accessible. The creel is placed in the upper part of the machine and the yarn is threaded directly to the burner and on to the cheese. —B.C.I.R.A.

Winding Machinery. H. Nisbet. *Text. Mfr.*, Jubilee Number, 1925, 97-107.

The development and improvement of winding machines during the last 50 years is traced. —B.C.I.R.A.

Ball and Socket Yarn Tensioning Device. J. Goretzki. *Leipziger. Monats.*, 1925, **40**, 432.

An improved thread-braking device of the ball in socket type for use particularly on reeling frames is described. The socket carrying the thread is pivoted and teeth on its underside mesh with grooves on the

base plate so that the socket can be rotated through any angle and fixed in position. The socket is provided with a vertical groove through which the thread passes when in the free position and with a circumferential groove into which the thread passes when the socket is rotated. Tension can thus be varied by turning the socket. The device is claimed to give more even tensions than are obtained with previous braking devices. —B.C.I.R.A.

(D)—Yarns and Cords

Folded Yarns: Calculations. *Text. Rec.*, 1925, **43**, No. 512, p. 47-48.

In connection with a previous article it is shown that the calculation of twist equivalents is a simple matter if a slide rule or alignment charts of a type previously described (*Text. Rec.*, 1921, **38**, No. 457, p. 43) are used. —B.C.I.R.A.

Patents

Improvements to Rectilinear Combing Machines. H. Vanhoutte. F.P.587,945.

This patent refers to a device for coupling the inferior nipper so as to protect the circular comb, which is characterised by the strengthening of this nipper by means of two rigid rods joined in one way on the bolts of the compression roller springs, and supported by the two arms of the nipper, and in the other way crossing a rigid bar. When the nipper is lowered it cannot meet the ends of the needles of the circular comb. —Bur. Text.

Improvements to Bobbin Holders. Etablissements Aug. Lepoutre. F.P.588,531.

The tubes are laid between two balls mounted with a free motion on spring plates. Each of these balls insures the maintenance of the tube. The spring blades are fixed in boxes. In the interior of each one is put a ball projecting through a circular opening hollowed in the bottom of each box, and the diameter of which is inferior to that of the ball. —Bur. Text.

New Card Clothing. Société La Française: Fabrique de garniture de cardes. F.P. 588,582.

The wires set in a clothing of cotton cloth are iron or steel and either round or flat, disposed normally or inclined, but without hooks. The advantage of this card clothing is to permit reduction to 7 mm. in the height of the wire and it is much less rapidly charged with fibres. —Bur.Text.

Carding Engine Web Divider. E. Ballsieper. D.R.P.406,993 (from *Leipziger Monats.*, 1925, **40**, 201).

The invention relates to card web dividers with several rubbing leathers by which the fleece from the doffer is divided by means of crossed steel bands between the dividing rollers and then led between dividing straps to the rubbing leathers. The steel bands are so arranged that the division of the web and also the carrying of the web ribbons to the rubbing leathers is done by the same steel band. —B.C.I.R.A.

Slubbing Frame Rope Driving Gear. Toothill & Snape, Ltd., and F. Bradshaw, Radcliffe, Lancashire. E.P.241,998.

Variable speed rope gearing for driving slubbing and roving frames in the preparation of cotton yarns comprises improved means for shifting the rope or ropes over the speed cones. The rope-guiding grids are carried on a rod which is of square section instead of round. The rod is a sliding fit in a carrier fast on a speed-changing rack which slides in a transverse bar. The rod slides along a guide rod which is supported by brackets which hook on to or are bolted over the bar. The lower grid is adapted to be raised on the rod in doffing and to be held raised by a spring catch which is released by a stop. When the cones are not one below the other, the rod may be in two parts held together by a bracket. —B.C.I.R.A.

Cleaning Waste Machine Clearer Roller. W. Wilkinson, Collyhurst, Manchester, and Fleming, Birkby & Goodall, Ltd., Halifax, Yorkshire. E.P.242,045.

A clearer roller for an engine cleaning-waste machine comprises shaped metal plates secured to a wooden roller by coach screws or bolts passing through holes in the plates. Some of the screws are arranged to pass through the bodies of the plates, whilst others overlap the edges of adjacent plates. Teeth are secured in holes in the plates. —B.C.I.R.A.

Winding Machine Tension Device. R. Cooper, Mansfield, Nottingham. E.P. 242,080.

A spring arm or like resilient guide is adapted to maintain a uniform tension on the yarn whilst permitting variations in the rate of travel or delivery of the yarn in apparatus for winding yarns, more particularly for winding cones, bobbins, &c., from hanks. One end of a wire is coiled round a porcelain or other suitable reel and the other extends therefrom as a spring arm which may be bent at right angles and carry a porcelain or similar guide. The arm may be guided by a hairpin or other guide. Any desired number of arms may be provided in one device, or any number of devices may be fitted in one machine so that each yarn is served, and the yarn is engaged by the arms as near the traverse guide as possible. —B.C.I.R.A.

Ring Spindle Reversible Tape Drive. Howard & Bullough, Ltd., Accrington, Lancs. E.P.242,241 (from *Text. Mfr.*, 1925, **51**, 417).

The tape drive described was designed to facilitate the change in direction of the

spindles in changing from weft way to twist way or *vice versa*. This is effected by adjustably mounting the jockey pulley in such a way that it can be readily tilted to right or left as required. Each jockey pulley is mounted on the upper arm of a weighted lever, the levers being fulcrumed on a common shaft extending the whole length of the frame. Through the action of the weight the pulley tends to move away from the cylinder and so maintain the tape at the desired tension. In changing twist the only change to be made is to tilt the jockey pulley in the opposite direction. This is done by slackening a set-screw and tilting the forked bracket in which the pulley is mounted. The tapes are then turned over and rearranged to run in the required opposite direction. —B.C.I.R.A.

Winding Machine Yarn Guiding Mechanism. W. Hirt, Berne, and J. Kappeler, Argovie, Switzerland. E.P.242,262.

In a winding machine a drum which drives the bobbins is provided with adjustable spring pins which alternately engage the yarn as it passes around the circumference of the drum from a reciprocating thread guide so that it runs in a zig-zag path around it and, when released from the pins as they are depressed by contact with the bobbin, is wound on the bobbin in cross-wound form. A lever operated by a feeler in contact with the bobbin may be provided to cause the pins to approach each other during the winding to form bobbins with conical ends, and inclined ribs may be used in place of pins. —B.C.I.R.A.

Combing Machine Waste Collector. J. L. Rushton, Kay Street Works, Bolton. E.P.242,344.

In an arrangement for removing the noil, waste, &c., from combing machines, casings, or brush, tins are provided around the brush at each head and are connected by tapering tubes to branch pipes of a manifold leading through a pipe to a main duct which serves a number of machines. The duct leads to a pneumatic delivery box where the waste is collected and delivered into a suitable receptacle. The fan is situated beyond the waste collecting box. Each tube is provided with a slot in which a perforated waste collecting plate can be inserted. The amount of waste collected on this plate in a given time can be weighed to determine the percentage produced by each head. In a modified arrangement the waste is collected on an aspirator and is removed from it by suction through a nozzle. —B.C.I.R.A.

Carding Engine Dust Removing Device: Description. F. Crompton and F. W. Sim, Brunswick Street, Oldham. E.P. 242,389.

Apparatus for the removal of dust from carding engines during the operation of stripping by a rotary brush is constructed without a hood or cover for the brush. The end members carry bearings for the rotary stripping brush. The side member is curved to conform to the brush and is formed with a suction chamber having an orifice extending from end to end. —B.C.I.R.A.

Raw Cotton: Oil Spraying. Borne Scrymser Co., New York, U.S.A. E.P.242,593.

Raw cotton stock is treated or sprayed before the completion of the drawing operation with a non-volatile lubricating oil. Pure mineral oil may be used, or castor or lard oil. The quantity used is between 0·5% and 4% by weight of the material tested. —B.C.I.R.A.

Artificial Silk Washing Machine. Naamlooze Vennootschap Nederlandsche Kunstzijdefabriek, Arnhem, Holland. E.P.242,612.

The pump or other usual circulating apparatus is dispensed with and the necessary vacuum is produced by arranging the washing tank with a long vertical discharge pipe, whereby the fall of the discharged liquid produces suction in the tank. —B.C.I.R.A.

Winding Machine Building Motion. Grimsley & Co. (Leicester) and G. Sellicks, St. George's Works, Leicester. E.P. 242,798.

The reciprocating screwed rod is intermittently rotated as it moves down through suitable connection with a sleeve by means of a one-way clutch. —B.C.I.R.A.

Yarn Doubling Apparatus. G. Leconte, Orne, France. E.P.242,943.

A twisting and doubling apparatus for yarns, threads, cords, cables, &c., comprises a frame carrying the bobbin and yarn tension device, and freely mounted on rotary shafts which are mounted eccentrically to each other and carry guide arms through which the material passes so that two twists are imparted to it for each revolution of the shafts. A shaft is driven by a pulley and rotates a second shaft through arms connected by a thread, cord, or wire. The frame remains stationary owing to the eccentric mounting of the shafts. The yarn is wound by means of a roller, a pressing-element and a drum. The apparatus may be arranged horizontally, the eccentric mounting of the shafts being dispensed with, and the lower part being weighted to prevent rotation of the frame. —B.C.I.R.A.

Carding Engine Motor Driving Gear. Siemens-Schuckertwerke Ges. Siemensstadt, Berlin. E.P.242,992.

In an arrangement for driving a carding engine by an electric motor the driving-member of the motor engages a gear

mounted in the cylinder between the bearings for the cylinder shaft, so that the motor is situated partly within the cylinder. The cylinder may rotate on a fixed shaft, which carries the motor entirely within the cylinder. —B.C.I.R.A.

Sized Viscose Threads: Manufacture. S. Toda, Sakai-gun, Fukui, Japan. E.P. 243,009.

In the manufacture of artificial silk, a number of freshly-coagulated filaments are gathered into a bundle without twisting and are passed through a sizing solution so as to produce a yarn similar to an untwisted natural silk yarn. Thus, a viscose solution is projected from capillary orifices into a coagulating-bath and the filaments formed, after washing and without twisting, are treated with a size containing gelatin, dextrin, &c., with or without wax, fat, resin, &c. Such yarns are suitable for knitting or for weaving either as weft or warp, and the sizing material is removed from the fabric by the desulphurising and bleaching baths. —B.C.I.R.A.

Winding Machine Tension Device. G. H. Thompson and G. Dronsfield, Oldham, Lancashire. E.P.243,141.

A yarn tensioning and controlling device for winding machines comprises a cone-shaped or parabola-shaped block and a floating ring of light material between which the yarn passes and holds the ring in suspension. The device is mounted on the stationary delivery spindle above the cheese or bobbin being unwound. The block is made of wood, metal, hard wax, or other material and is dished on its underside to rest flat against the head of the bobbin. —B.C.I.R.A.

Combing Machine Comb. J. W. Nasmith, Heaton Mersey, Manchester. E.P. 243,215.

The needles are cylindrical for a part of their length and then conical for the remainder. They are attached to the blade in the usual manner and are stouter than usual. —B.C.I.R.A.

Spinning Spindle Roller Bearings. P. Brühl, Düsseldorf, Germany. E.P. 243,271.

In a bearing for spinning spindles in which rollers bear directly on the spindle, the rollers are guided axially by collars rigidly secured to the spindle so that when the spindle is withdrawn from the bearing casing it carries the rollers with it. The rollers are carried by a cage having an annular upper part and downwardly extending fingers separating the rollers. A spring ring in the lower end of the cage prevents the rollers from falling out when the spindle is removed from the casing. The outer surface of the lower collar is tapered to facilitate the passage of lubricant up the spindle to the rollers. Excess of lubricant passes over the top edge of the casing into an annular groove, down a passage to the interior of a tube and thence through a hole to the spindle. In a modification in which a roller spacing cage is not used, the collars are increased in diameter so that the distance between the outer surface of the collar and the inner surface of the whorl, which is fixed to the spindle, is less than the diameter of the rollers. To assist the rollers into the operative position when replacing the spindle, the upper edge of the spindle is tapered. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Preparatory Processes—

242,469. C. de Molinari. Feed mechanism for scutcher.

242,549. W. Prince-Smith and D. Waterhouse. Combing machine: motor drive.

242,947. G. A. Seelemann and Sohne. Wire for cards.

Spinning—

242,047. W. B. Wilson and Wilson and Co. Flanged bobbin.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Artificial Silk: Winding and Weaving. — Stott and J. Kenyon. *J. Nat. Fed. Text. Works Managers' Associations*, 1924-1925, **4**, 70-79 and 222-226.

Some general notes on the preparation, storage, winding, and weaving of artificial silk yarns, with particular reference to viscose. —B.C.I.R.A.

German Textile Industries; Machinery in——. Progress during 1925. H. Eigenbertz. *Text. Rec.*, 1926, **43**, No. 515, 89-91.

Among other machines for raising fabric and treating yarn previous to weaving is a description of a carbonising machine for woollen piece goods. The machine is heated by means of hot air and contains special arrangements for preventing curling of selvages and for taking-up slack in the acid-impregnated fabric; excess of acid is removed from the fabric during its passage over a suction-slot. —A.J.H.

(B)—Sizing

Warp Thread: Extension in Sizing. *Leipziger Monats.*, 1925, **40**, 70.

In reply to a question, it is stated that warps invariably stretch during sizing and on the loom, but no allowance for this extension should be made in costs calculations. In cylinder sizing machines the extension is fairly great, especially if the size rollers have no friction drive. Sucker

Bros. avoid stretching in their machine by providing the drying cylinder with ball bearings and driving the size rollers. In the Schönherr machine the cylinder and size rollers are friction driven to counteract stretching. —B.C.I.R.A.

Amylase: Effect of Hydrogen-ion Concentration; and Starch: Hydrolysis. P. Petit and Richard. *Comp. Rend.*, 1925, **181**, 575-577.

Starch was hydrolysed by amylase in 0·2% solution obtained by mechanical agitation for 30 minutes in the cold and with the addition of phosphates, sodium carbonate, or lactic acid to give varying hydrogen-ion concentrations. The *p*H of the saccharified liquid was determined potentiometrically and the amount of maltose formed determined. It was found that for a variation in *p*H of from 8 to 3 the hydrolysis became more and more difficult towards the two *p*H limits; at *p*H 9·8 hydrolysis was effected only after some hours. A series of tests were made by dissolving amylase in (1) boiled water, (2) water saturated with hydrogen, and (3) water aerated. Maximum maltose formation occurred in the three cases at a *p*H 4·2, a figure corresponding to the neutral point of sensitive Methyl Orange. Maltose production was greatest in boiled water solution; the lowering effect of hydrogen being a little less than that of air; in alkaline solution the greatest amount of maltose was given in the hydrogenated solution and in acid medium (*p*H 3·2) the boiled water and hydrogenated water solutions gave the same result; the quantity formed in aerated water solution was much less. The absence of air during solution of amylase is thus favourable to the formation of maltase and the presence of air is less harmful in alkaline than in acid solution. The authors derive a simple linear relation between the quantity of maltose formed and the hydrogen-ion concentration of the medium. —B.C.I.R.A.

Antiseptics and Aktivin: Application. R. Feibelmann. *Melliand's Textilberichte*, 1925, **6**, 586-587.

The author calls attention to Straszewski's omission of Aktivin, a preparation fulfilling all the requirements of an antiseptic for the textile industry and capable, simultaneously, of hydrolysing starch. He points out, also, that formaldehyde is less generally applicable than Straszewski states. As it is a precipitant for proteins it cannot be used in size and finishing mixtures containing glue. —B.C.I.R.A.

Sizing. *Melliand's Textilberichte*, 1925, **6**, 617-618.

The following replies were received to a question whether the sizing process could be carried out without steam, using only hot air: (1) A number of sizing machines provided with gas-heated air furnaces have been in use for some time. These furnaces have been technically perfected until they now have an efficiency of 97% and the system has many advantages over the steam heating system. (2) A cold sizing process is recommended. (3) The writer refers to the electrification of sizing machines, but is of the opinion that the direct use of coal is the cheapest method of heat production and its conversion to electricity or gas for dry air production is wasteful. (4) The installation of an electric boiler is recommended if the current is produced on the premises. The method is too expensive if current is purchased. Under these conditions a low pressure boiler is advocated. Air heaters heated directly by coal are practicable but less economical than the electric boiler. —B.C.I.R.A.

Metallic Chlorides: Application. —Cooper. *J. Nat. Fed. Text. Works Managers' Associations*, 1924-1925, **4**, 127-134.

A general article dealing with the use of metallic chlorides in sizing. The following points are emphasised—Soap and metallic chlorides must never be used together. Magnesium and calcium chlorides encourage rather than prevent the growth of mildew and should only be used with zinc chloride or other efficient antiseptic. Zinc chloride is an antiseptic for mildew if used to the extent of 8%, or more, calculated on the dry weight of the starches, but in small amounts it does more harm than good. The percentage should be increased to 10% if much magnesium or calcium chloride is used in the mixing. If zinc chloride cannot be used for export goods, salicylic acid should be tried. Zinc, aluminium, magnesium, and ammonium chlorides are all debarred in the sizing of fabrics for bleaching. —B.C.I.R.A.

Warp Yarn: Sizing and Drying. *Text. Mfr.*, 1925, **51**, 424-426.

The writer intends to show that with a given size suitably prepared, the efficiency of the sizing operation can be markedly altered by differences in—(1) Method of applying the size, and (2) method of drying the sized warp. (1) Any sizing apparatus should have some device for maintaining the size at constant level in the size box and some form of automatic control for the temperature of the size. If these two controls are not present, irregularities in the sizing will occur. (2) As regards the method of drying, two important considerations are mentioned (*a*) prevention of deterioration of the material being sized, and (*b*) economy of steam consumption. (*a*) The drying process should be carried out at as low a temperature as possible to prevent crumbling and corresponding loss of size as well as tendering, both from actual heating and from loss of protecting size in subsequent processes. Automatic

temperature control is suggested to prevent undue heating in drying apparatus. Circulation of warm moist air is very important in the drying chamber. (*b*) Economy may be obtained by the use of exhaust low pressure steam for drying the sized warp. Insulation of the housing of the dryer is very important both for economy in steam used and for comfort in working conditions. Both (*a*) and (*b*) are considered in the suggestion that each layer of steam coils should have a separate shut-off valve, which economises and prevents excessive heating of the warp, if it has become dry at any stage before completion of its passage through the dryer. —L.I.R.A.

Sizing. F. J. Cooper. *Text. Mfr.*, Jubilee Number, 1925, 61-65.

A general review of 50 years' progress in sizing practice. —B.C.I.R.A.

X-Ray Structure of Starch. See Section Ic.

(C)—Weaving

Undyed Pattern Fabrics: Weaving. J. Funke. *Leipziger Monats.*, 1925, **40**, 17-18.

The production of pattern effects in cloth without the use of coloured yarns and relying only on the combination of different weaves is discussed. —B.C.I.R.A.

Artificial Silk: Weaving. *Kunstseide*, 1925, **7**, 256-260.

A further contribution to the applications of artificial silk in weaving novel fabrics. Directions for weaving a number of ribbed materials including reps and ottomans are given. —B.C.I.R.A.

Looms: Development. F. Chadwick. *J. Nat. Fed. Text. Works Managers' Associations*, 1924-1925, **4**, 19-31.

A general article on the development of hand, power, automatic, and electric-driven plain looms. —B.C.I.R.A.

Shuttles; Manufacture of——. R. Halstead. *J. Nat. Fed. Text. Works Managers' Associations*, 1924-1925, **4**, 195-206.

A general article on shuttle making, dealing with the growth of the principal wood-providing trees, the conversion, seasoning, and compression of the timber, the making of the shuttles, shuttle pegs, designs in shuttles and the shuttle in relation to the loom. —B.C.I.R.A.

"Holliday" Dobby Mechanism. H. Livesey, Ltd. *Text. Mfr.*, 1925, **51**, 345-396.

A simple, direct-lift dobby in which the number of working parts is reduced to four, namely, the feeler, hook, presser, and jack, is described. There are no needles or inside grids or grates. All the feelers, hooks, and jacks have the same thickness of fulcrum bore which allows them to be made of robust construction and also allows them to form their own grids. There are no knuckle joints to the jack connections, all actions being performed direct and with the minimum amount of friction. All parts are interchangeable. —B.C.I.R.A.

"Climax Super" Spring Top Heald Reversing Motion. Lupton & Place, Ltd. *Text. Mfr.*, 1925, **51**, 346.

The patent spring top motion described combines maximum simplicity with minimum wear. There are no teeth, links, knuckle joints or other connections subject to friction and wear. The only metal parts subject to wear are the hubs of the pulleys and the two spindles on which they are mounted. These spindles are lubricated by a special greasing arrangement. A groove is cut the length of the spindle from which lubricating grease is forcibly exuded when required by simply turning a cap on the front end of the spindle. The whole arrangement is bolted to the top rail of the loom and details of the mechanism are given. —B.C.I.R.A.

Souczek Loom. H. Nisbet. *Text. Mfr.*, 1925, **51**, 382-384.

The loom described is a fast-reed, 54 in. loom running at 240 picks per minute and driven by a 1 in. leather belt from an electric motor of 0·8 h.p. Its special feature is a novel type of picking motion in which the shuttle is propelled by rapidly revolving grooved friction discs acting in conjunction with compressed spiral springs. A pair of friction discs mounted on ball bearings and revolving continuously at a speed of 2,500 r.p.m. is arranged at each end of the sley immediately opposite each sley sword, whilst behind each shuttle box and about midway between the box end and the entrance, a metal cylinder enclosing three spiral springs is fixed in a vertical position. There is no swell, so that the latent energy of the shuttle is utilised to the full. A leather check strap attached to two cam levers pivoted near the upper and lower ends of the metal cylinders, is in a vertical position when it receives the impact of the shuttle. As the shuttle moves further into the box it is deflected, partially rotating the cam levers which cause the spiral springs to be compressed. A brake which holds the shuttle at rest in the shuttle box is released when the shuttle is to be picked, and the stored-up energy of the springs starts the shuttle on its journey, whilst the impetus required to carry it across the loom is provided by the high peripheral speed of the friction discs. Two other features of the loom are a new "frog" or stop rod device and the use of powerful compression springs adapted in the construction of the crank connecting arms to yield and thus to absorb the shock of the impact of the frog blades against the frogs

when the shuttle fails to enter the box, and to unship the driving belt and stop the loom without risk of breakage.
—B.C.I.R.A.

Power Loom Developments. W. Wilkinson. *Text. Mfr.*, 1925, Jubilee No. 1875-1925, pp. 67-95.

A review of improvements effected in loom construction and weaving practice during the last 50 years. After a general discussion of the flyshuttle principle of the power loom and attempts to modify it, detailed consideration is given to the following features—Shedding motions, healds, reeds, tappets, dobbies, jacquards, warp tensioning arrangements, picking motions, beat-up motions and automatic weft replenishment. —L.I.R.A.

Regan Warp Stop Motion. H. Livesey, Ltd. *Text. Merc.*, 1925, **73**, 469.

In this mechanism the slot cut in the middle of the drop wires is narrower at the top than throughout the rest of its length. When the wires are in the normal position the oscillating rod passing through them can be freely turned, but when an end breaks and the wire falls, the reduced width of the slot prevents the rod from turning and actuates mechanism by which the loom is stopped. When the wire drops it is slightly twisted, spreading the other wires and so indicating the position of the broken end. —B.C.I.R.A.

Weaving of Artificial Silk. See Section 3A.

(D)—Knitting

High Speed Knitting Loom. *Silk Jl.*, 1925, **2**, No. 19, p. 60.

This machine has been designed to give high production in tricot and glove fabric made from silk, cotton, or rayon. It is made in standard sizes, and is belt-driven at a speed of 180-230 meshes per minute. The output is about 20 yds. every two hours. It is worked on the usual feed-from-below principle, the fabric being always visible. The top cloth roller can be reversed by a lever, thus making the operative position of the needle easily accessible. The loom is simple in design and operation, and works without vibration. The warp beams are below, ensuring steadiness and absence of swaying. —F.G.P.

Artificial Silk: Knitting. W. E. Boswell. *Text. Rec.*, 1925, **43**, No. 512, 73.

Some general defects occurring in the knitting of artificial silk, and their appropriate remedies, are discussed.
—B.C.I.R.A.

Hosiery Knitting Needles: Control. W. Davis. *Text. Mfr.*, 1925, **51**, 334-335.

Some of the outstanding deficiencies in hosiery knitting needles are pointed out and the importance of a careful scrutiny before putting into use and suitable storage and temperature conditions during use are emphasised. —B.C.I.R.A.

Folding of Hosiery Yarns. See Section 2C.

(G)—Fabrics

Velveteen: Manufacture. J. Harrant. *Melliand's Textilberichte*, 1925, **6**, 728-729.

A general article explaining methods of weaving and finishing weft pile cotton velvets. —B.C.I.R.A.

Silk Pongees in Far Eastern Asia. *Silk Jl.*, 1925, **2**, No. 19, p. 55.

These are produced from Manchuria and Shantung wild silk; the worms feed on oak leaves. The late advance in popularity of these fabrics was due to improvements in bleaching, enabling the use of the most delicate dyes, but it has fallen off again, the exports during 1923 being only half in quantity and rather more than half in value of those of 1921. The cocoons reach Shantung in October, having been dried in ovens, and are stored for six months, then softened by steam and reeled. Any number of cocoons from 8 to 16 are used for a thread; the raw silk is brushed over with a mucilage made of beans, dried, and then woven on hand looms into 20 yd. pieces. To cleanse and improve the colour the fabric is boiled for three hours in an iron cauldron with 2 oz. of pig fat to 30 oz. of silk, and after being washed twice in running water and flattened in a wooden mangle, is semi-dried and folded. The looms are home made with bamboo reeds; German looms with steel reeds were found to break the warp-ends. There are about 130,000 workers of silk in Changi. The silk is sent all over the world and is used for many purposes including aeroplane wings. —F.G.P.

Crêpe-de-chine. J. Chittick. *Silk Jl.*, 1925, **2**, No. 19, p. 39.

The warp is laid on the loom 43 in. wide to give the standard 39-40 in. The reed is generally 60 dents, though 65 and 70 are sometimes used. The ends are woven double or triple with two or three to the dent. A standard construction is 240 ends per inch but for finer qualities it may be as many as 420 ends (70/2/3). The usual silk is white Japan raw of 20/22 denier; occasionally a coarser silk up to 24/26 den. is used. Yellow Japan has a boil-off of 22% and is therefore less used than the white, which has 19%. A strict best extra is quite suitable. The weft is 13/15 den. white Japan of Best No. 1 to extra quality. 14/16 den. Canton is also used, but is not so clean. A three or four thread with 70/65 twists per inch is usual, half twisted each way. All twist one way would give a heavy crêpon effect. The fabric is woven 2 and 2 threads of either twist on a 2×1 box loom. In

throwing, the greatest care must be taken to keep the twist regular or irregular shrinkage will occur. Fugitive stains are used to make the right twist from the left. Care must be exercised in weaving that sharp points on the sand-roll do not cut the threads, for the weighting is heavy on the loom. Crêpes-de-chine should always be allowed, in finishing, to run up about 2% in length. If more figure is desired, this may be increased to 6%. —F.G.P.

Patents

Electric Weft Feeler. Ateliers de Constructions Diederichs. F.P.586,799.

Comprises two conducting isolated blades supported by a piece joined to the plate of the shuttle box. By oscillation, these blades are brought in contact with the cop through the normal opening of the shuttle. When the metallic blades are in contact with the metallic support of the cop the circuit is closed and the machanism of cop changing operates. The electro-magnet is disposed under the breast beam. —Bur.Text.

New Dobby. C. Larger. F.P.586,806.

Each wire hook commanding the raising or the lowering of the shafts is in two distinct parts, joined by an elastic disposal formed by a spring with two legs. The superior end of each part is engaged in a piano system, the motion of translation being driven by an oscillating level depending from a set of cards. —Bur.Text.

Creel for Looms, Warping Machines, &c. G. Kershaw, Atlas Iron Works, Rochdale. E.P.241,962.

In this creel the frame carrying the thread guides and tension devices is fixed whilst the frame carrying the bobbins of thread is movable to and from the thread guide frame to facilitate renewal of the bobbins, &c. The frames may be in sections and the sections of the bobbin-carrying frame movable separately; the sides of the frame may be parallel or inclined to one another. The creel shown comprises vertical posts, longitudinal connecting members, and two series of longitudinal rods, on which blocks carrying two thread guides and a tensioning device are secured by set screws, one block for each thread. Posts at one end of the frame carry guide bars through which the threads pass to the beaming or other machine. The movable frame comprises vertical posts suspended from wheel trucks running on cross bars. Longitudinal inclined bars carrying the bobbin pins in line with each of the guide blocks are secured to the posts. The frame is moved first to one side and then to the other by chain, &c., gearing to permit the replenishing of the bobbins, and is then moved to its central position inside the fixed frame. —B.C.I.R.A.

Woven Fabrics. W. Holt & Sons (Walshaw), Ltd., and J. W. Holt, Victoria Mills, Walshaw, Bury. E.P.241,973.

A fabric woven similarly to that described in Specification 2036/11, but with a hard twisted weft, is used for towels, bath sheets, glass cloths, embroidery cloths, table linen, dress fabrics, underwear, &c. The heavily weighted back warp contains preferably twice as many threads as the face warp, which is lightly weighted. The back warp threads are lifted at even-numbered picks and the face warp threads at odd-numbered picks. For figurings which may be effected by a tappet or dobby, the face warp threads are also raised at even numbered picks. The warp threads, which are preferably coarse and may be of same or unequal counts are drawn in alternately, one from the face warp and one from the back warp. Two back warp threads may be drawn in as one. The cloth has one side absorbent and the other side of a hard cellular structure. —B.C.I.R.A.

Warp Knitted Fabrics. Frymann and Fletcher, Ltd., and S. S. Fletcher, Radford, Nottingham. E.P.242,000.

Horizontal stripes, checks, and like effects are produced by using ground and face threads, the latter of which are alternately lightly and heavily tensioned to give a looped pile face and a plain face respectively. One ground thread is used for each needle and each thread is traversed over four needles, for example, pillaring on alternate needles. A full set of facing threads is also employed, each being traversed over ten needles, for example, three at a time. For striped effects, the full set of face threads are taken from one beam which has the usual light tension means and is heavily braked at intervals. For checks the facing threads are divided into sections taken alternately from two separate beams, the beams being alternately lightly and heavily tensioned. By introducing a variety of coloured threads and varying the periods of heavy tension other effects may be produced. By using two full sets of facing threads differing in colour or material, and alternately heavily tensioned, a striped fabric having a continuous pile face is obtained. Each beam is braked by a shoe mounted on a weighted lever. The brake is relieved at intervals by the action of a stepped cam which is fed forward by a ratchet and pawl from a cam. —B.C.I.R.A.

Brocade Smallware Loom. C. Pizzorno, Varazze, Italy. E.P.242,007.

A power loom provided with a jacquard is adapted for the production of smallware brocades. Use is made of a brocade batten comprising a bar guide in its vertical movements by slots on the bar engaging studs mounted on a support. On the bar are fitted segments on which are supported

horseshoe shaped sectors by means of ring-shaped projections and rings. The sectors carry the bobbins. They are turned by a rack and the rotary movement, in combination with the rising and falling of the brocade batten and the operation of the jacquard mechanism, produces the brocade pattern. Brocades of two different colours may be produced by providing alternate bobbins of different colours on a brocade batten mounted on balls, to-and-fro movement being imparted to the battens to bring the desired colour into operation, the unwanted colour running idle until shifted into working position. —B.C.I.R.A.

Dobby Loom Change-box Mechanism. F. Volech, Vrchlabé, Czecho-Slovakia. E.P. 242,076.

A card or lag-saving device for the change-box motion of a dobby loom comprises a roller having a helical row of lugs arranged to engage successively with push bars selected by a pattern cylinder. The two lifting bars which move the drop box in opposite directions are each operated by a frame against which abut a number of push bars arranged in alternate arrangement with the two frames. Each push bar has a lug which is engaged when the bar is raised by one of a series of lugs helically arranged on a cylinder. The push bars are selectively raised by the pegs of a pattern cylinder. The lugs are made wide enough to span two push bars, one for each frame. The roller is rotated intermittently by pawl and ratchet mechanism.

—B.C.I.R.A.

Shuttle Threading Device. A. Maden, Waterfoot, and J. Sowerbutts, Bacup, Lancashire. E.P.242,081.

A suction device for threading loom shuttles comprises a cylinder pivoted to a standard and containing a hollow piston to which is pivoted a lazy-tongs device. The levers of the device are pivoted to the standard and their free ends engage in slots in the cylinder. A hollow T-piece supporting a rubber seating is mounted on the cylinder. Passages in the T-piece and seating communicate with an opening in the cylinder. A spring maintains the cylinder in its normal position. A shuttle is placed with its eye against the opening in the seating and is pressed against it to move the cylinder downwards. The piston is thus drawn rearwards in the cylinder and sucks the weft through the shuttle eye. The piston is packed by leather discs. A screen is placed over the cylinder opening to prevent fluff being drawn through it.

—B.C.I.R.A.

Loom Picking Motion. Bergmann Elektricitäts Werke A.-G., 64 Seestrasse, Berlin. E.P.242,255.

In looms in which the shuttles are actuated by cam or crank operated pickers, the picking devices are operated independently of the speed of the rest of the loom, so that a predetermined minimum force is exerted in all cases. The picking cam may be operated from a shaft which is driven independently of the loom main shaft, though the latter may be driven therefrom by bevel gearing and friction gearing giving a greater or less speed to the main shaft. The picking cam and a controlling disc may be loosely mounted on the shaft and be connected to it at the required times for picking by means of a coupling sleeve and a pin on a rod or arm pivoted and controlled by a cam on the main shaft. The disc causes the disengagement of the pin after rotation of the picking cam and disc, a braking bar stopping the cam in the required position. Two picking cams may be mounted on the main shaft.

—B.C.I.R.A.

Loom. Maschinenfabrik Rüti vorm. C. Honegger, Zurich, Switzerland. E.P. 242,301.

The lay or batten comprises an iron rail, of angle or other rolled section such as a channel bar, extending across the loom and secured by screws to the two supports. A wooden shuttle race board is secured by screws to the central part of the rail, whilst a stop for the sheet or reed is secured to the rail by bolts. A head strip is glued to the top of the race board. Shuttle boxes are secured by screws to each end of the rail and are vertically and horizontally adjustable, a space for the weft fork being provided between the left shuttle box and the race board. The invention is applicable to automatic looms and to both over-pick and under-pick looms. —B.C.I.R.A.

Warp Balling Machine. G. Kershaw, Atlas Iron Works, Rochdale. E.P. 242,319.

In a machine for balling warps, the cross-traversing slide is provided with a swivelling, tilting, or otherwise yielding guide to the rear of the fixed guide which preferably has two inclined sides joined by a curved surface so that the yarn in tape form may slip from side to side without turning over. The fixed guide has slotted lugs for attachment by screws to inclined lugs on the slide. The slide may carry a third guide consisting of a bar with a rounded surface or two such bars separated by distance pieces. —B.C.I.R.A.

Lace Machine Bobbin Thread Deflecting Bars. F. H. Willatt, Sherwood Rise, Nottingham. E.P.242,397.

Bars for deflecting bobbin threads of twist lace machines from the normal path to the facing bar are adjustably mounted on brackets bolted to the point bars. The deflection can be increased by offsetting the thread-eye of the carriage. By these means fabrics differing in appearance from the normal product of lace machines can be

obtained and double and tubular fabrics of the kind in which the bobbin threads are slacker than the warps can be made of more uniform appearance than hitherto. —B.C.I.R.A.

Knitting Machine Stop Motion. W. Baker (Leicester), Ltd., and W. Baker, Newarkes Bridge, Leicester. E.P. 242,401.

The yarns in passing across the forked ends of fixed guides hold up droppers each fixed to pivoted plates held out of contact with studs. When contact is made an electric circuit is established. —B.C.I.R.A.

Fur-pile Fabric Loom. Morton Sundour Fabrics, Ltd., J. Morton, Carlisle, and J. B. Webster, Lancaster. E.P.242,428.

In a loom for making fur-pile fabric in which a fur-carrier is reciprocated on the lay, the carrier is a solid, or a wholly or partially filled shuttle having anti-friction fur guiding means such as rollers. The fur passes from a can, through a stationary guide and an eye slidable between stops on a rod, over the open reed to the carrier. The can may be replaced by a suitably driven swift delivering through a long box, slotted at the bottom, to the eye. The dents of the reed are bevelled. —B.C.I.R.A.

Woven Looped Fabrics: Manufacture. F. H. Willatt, Sherwood Rise, Nottingham. E.P.242,430.

Looped fabrics somewhat resembling knitted fabrics but less liable to ladder are made on twist lace or like machines by causing slack bobbin threads to loop or hank with the warp threads. The mechanism described in Specification 242,397 may be used for this purpose. Three types of fabrics obtainable are illustrated. —B.C.I.R.A.

Knitting Machine Stop Motion. Crawford Manufacturing Co., New Brunswick, New Jersey, U.S.A. E.P.242,437.

When a thread is subjected to excessive tension, a hook over which it passes is drawn down and a corresponding rod turns a disc and acts on trip mechanism contained in a casing. Full details are supplied. —B.C.I.R.A.

Shuttle Threading Device. Tattersall and Holdsworth's Machinefabrieken en Magazijnen de Globe and J. Tattersall, Enschede, Holland. E.P.242,527.

The weft thread is passed round an inclined peg and through a slit in the shuttle-head so that a double strand lies in an axial passage intersecting the thread passage. The thread is then pulled through the passage by a hook passed through it. The thread may be left round the peg for extra tension. The peg is of hard wood or porcelain-covered metal. —B.C.I.R.A.

Elastic Materials: Weaving. Clutsom and Kemp, Ltd., and C. Clutsom, Highfields, Coalville, Leicestershire. E.P.242,542.

Instead of the customary single elastic thread used as a warp in the weaving of elastic webs, two or more elastic threads are used. These may be covered with cotton, &c., or not. —B.C.I.R.A.

Knitting Machine Stop Motion. Crawford Manufacturing Co., New Brunswick, N.J., U.S.A. E.P.242,545/6.

A trip device for stopping a stocking or other knitting machine on the breakage or exposure to excessive tension of any one of a number of threads fed to it, is housed in a casing mounted on a standard above the machine and comprises a plate mounted on a shaft and turned by a coil spring to actuate certain connections and stop the machine. A thread-guide for use in connection with stop motions consists of a fixed U-shaped plate, slotted, and a correspondingly ribbed trip plate mounted on a rod which, when rotated by the fall of the plate, actuates the stop motion. —B.C.I.R.A.

Warp Beam Piecing Cloth. Soc. Anon. A. Saurer, Arbon, Switzerland. E.P. 242,577.

The piecing cloth of a warp beam, having the usual hollow in which the knotting-end of the warp lodges, is provided with a covering member so that, during winding, it bridges the hollow. —B.C.I.R.A.

Shuttle Threading Device. C. Bourgeois, Rouen, France. E.P.242,610.

In shuttles having automatic or hand-operated threading means, including a slot leading to an outlet eye which may be situated in a longitudinal slot, recesses are formed at each side of the eye and are connected by a straight longitudinal slot cutting the eye. The slot is of just sufficient width to receive the yarn and of sufficient depth to reach the bottom of the recesses. Kinks or tangles formed in the yarn lodge in one or other of the recesses when the shuttle is thrown and do not reach the eye, so that unthreading is obviated. The recesses may also be used in a shuttle having no longitudinal slot, so that consequently the orifice of the outlet eye is flush with the surface. —B.C.I.R.A.

Shuttle Threading Device. C. Bourgeois, Rouen, France. E.P.242,611.

A sheet-metal threading device for loom shuttles consists of two horizontal portions connected by a doubled inclined body portion. The head has a nose and a curved edge which guides the weft, passed round the nose, to a slot leading to the shuttle eye. The length of weft passing from the shuttle-peg at the same time slides down the body portion into a T-slot therein.

The device is positioned by a screw and a tongue which engages a groove. The shuttle nose is bevelled away to assist in manipulating the weft and is grooved to receive the threader. An opening is provided in the threader to take up ballooning thread. The shuttle may be threaded by hand or automatically, and in the latter case an additional upwardly and backwardly curved plate may be fitted to guide the thread to the top of the slit. The nose may be dispensed with. —B.C.I.R.A.

Braiding Machine Bobbin Carrier. Soc. Anon. des Etablissements Leflaive and J. J. Knecht, 5, Avenue du Coq, Paris. E.P.242,637.

The whole of the let-off and thread-guiding apparatus of the bobbin carrier is mounted on a cap removably attached by a spring catch to the spindle and forming a stop which prevents the bobbin from rising. The thread passes through eyes in the lower end of a weak spring, an angle piece, a pawl, and a guide. These parts are all mounted on the cap. The thread also passes through a porcelain eye, mounted either on the cap or on the spindle and supports a tension spring which disengages the pawl from the ratchet when the reserve of thread is used up. The use of this device permits the thread supply to be of maximum size. —B.C.I.R.A.

Lace Machine Bobbin Carriers. Soc. Anon. des Etablissements Leflaive and J. J. Knecht, 5, Avenue du Coq, Paris. E.P.242,638.

In lace machines in which the bobbins are driven by centre discs a method of locating the securing means is adopted by which it is possible to have the bobbin carriers proportionately larger or the carrier drive heads proportionately smaller, since the edges of the bobbin carrier shoes may extend nearly to the axis of the carrier drive head. The arms of the centre discs may extend above the level of the race plate so as to act on both shoes. Intermittent movement is imparted to the bobbins by sleeves sliding on squared parts of shafts and engaged with or disengaged from teeth on continuously rotating intermeshing gear wheels by jacquard action. —B.C.I.R.A.

Pile Fabric Loom Tube Mechanism. Platt Bros. & Co. and F. W. Austin, Oldham. E.P.242,682/3.

Tube frame mechanism for looms for weaving tufted pile fabrics is described. —B.C.I.R.A.

Electro-magnetic Loom. G. Gourdon, Montmorency, Seine-et-Oise, France. E.P.242,701.

The warp let-off, cloth take-up, shedding, beat-up, and picking motions are each effected by one or more pairs of electromagnets controlled by a single switch. Details of the mechanism are given. —B.C.I.R.A.

Circular Knitting Machine Striping Mechanism. Trent Engineering Co. Ltd. and W. Lacey, Trent Works, Nottingham. E.P.242,735.

In machines provided with a striping or patterning attachment automatic means are provided for bringing the striping attachment into action and also for cutting out the splicing thread without stopping the machine on the completion of a heel or toe and the resumption of continuous work. —B.C.I.R.A.

Picker Checking Device. A. H. C. Rousseau, Ghent, Belgium, and H. Moore, Hipperholme, Yorkshire. E.P. 242,744.

A device for checking picking sticks consists of two levers pivoted to a bracket secured to the loom frame and connected at one end by a spring and at the other end by a strap. At the point where the picking stick strikes the strap this may be provided with a renewable piece of strap. —B.C.I.R.A.

Knitting Machine Feed Mechanism. E. G. Beasley, Leicester, and H. S. Deacon, Fleckney. E.P.242,775.

An initial tension put on the yarn as it passes from a full bobbin is automatically and progressively reduced to compensate for the normal increase in tension due to the supply becoming exhausted. It is stated that stockings and other articles can thus be knitted of a more nearly uniform length and texture than would otherwise be the case. —B.C.I.R.A.

Circular Knitting Machine. V. Lombardi, Brooklyn, N.Y., U.S.A. E.P.242,801.

Multi-coloured fabrics are knitted on machines provided with four sets of needles, which differ as to the length of the butts and also as to the position of the butts relative to the hooks. A detailed descriptiin of the arrangement is given. —B.C.I.R.A.

Loom Fringing Motion. F. & A. Fielden, Heaton Moor, Lancashire. E.P.242,863.

In a fringing motion, pegs on a measuring lattice on a barrel raise an arm connected by lever and link or cable devices to a spring-controlled mask or guard, thus unmasking a wheel geared to the take-up roller and enabling it to be turned by a pawl carried by two arms to form a thin place or fringe. The arms are oscillated by a link and a crank pin. —B.C.I.R.A.

Pile Fabric Loom Cutter Holder. Lox Seal Corporation, Brooklyn, N.Y., U.S.A. E.P.242,945.

The cutter of a pile wire for forming and cutting loops of warp thread is detachably secured in a channel-shaped holder provided with means for preventing relative movement between the cutter and holder.

One of the walls of the holder is bent to enter a recess in the other wall which is extended and curved and is provided with a pressed-out spring tang adapted to engage a slotted part of the cutter. The cutter is inclined to co-operate with the inclined surface of the bent part of the wall. The blade has an inclined cutting-edge and can be removed for replacement by breaking off the part and moving the blade to the right. —B.C.I.R.A.

Pile Fabric Loom Reed Dents. Mohawk Carpet Mills, Amsterdam, N.Y., U.S.A. E.P.242,949.

In a pile-fabric loom the reed dents have rectangular lower parts fitting in slots in a base, thickened curved middle portions, whereby the spaces between the dents are restricted, and upper rectangular ends widened by splitting the dents so as to form restricted spaces at the top. Ears are formed at the upper ends of two or more of the dents to receive a retaining wire, which is substantially level with the upper rear corners of the dents, thus allowing for a maximum upward movement of the warp threads, and enabling the knife to cut the tufts close to the ground fabric. —B.C.I.R.A.

Stitched Thread Fabrics. S. C. Toker, Gohlis, Leipzig, Germany. E.P.243,120.

A plain or ornamental fabric is formed entirely of interlaced stitches worked over weft threads. A border of threads is tacked on to a backing and successive rows of stitches are laid down starting from the border thread, the thread from the end of a row being brought back to form the weft thread for the succeeding row. When ornamental effects are required the figures are outlined by thread tacked to a backing and filled in as above. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Weaving—

242,407. J. Walker. Loom seat.

242,795. J. Scott & Sons, Ltd., and A. Mudie. Shuttle guards.

Knitting—

242,563. Mercury Mills, Ltd. Knotting device for knitting machines.

Fabrics—

242,422. Carpet Trades, Ltd., and C. Osborne. Lap-forming apparatus for felt fabrics.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming.

Scouring: The Importance of Good, in the Bleaching of Cotton and Linen Fabrics. W. Kirk. *Text. Mfr.*, 1926, **52**, 24-25.

The author emphasises the importance of thorough scouring in bleaching cotton and linen. Two important conditions for satisfactory scouring are (*a*) even piling of cloth in the kier and (*b*) thorough saturation of the cloth with the liquor. The combined piling and saturating machine made by Sir James Farmer Norton & Co., Salford, Manchester, which can be fitted to almost any type of vertical cylindrical kier, is designed to ensure that these conditions are realised. The author has found the machine to be extremely effective. —L.I.R.A.

Wool Scouring: Theory and Practice. *Text. Rec.*, 1926, **43**, No. 515, 53-55.

The first part of a discussion on the impurities in wool and their removal by means of aqueous scouring liquors or volatile solvents. —A.J.H.

(C)—Washing

Washing and Softening Wool: Use of Soap. *Text. Rec.*, 1926, **43**, No. 514, 54-55, and No. 515, 57.

A detailed discussion, based on large scale experience, on the function of soap in the cleansing of raw wool by means of the multi-bowl type of wool washing machine, having particular regard to economy in the use of soap. By means of special methods described the amount of soap may be reduced to about 0·5 g. per 1 kg. of combed wool. Suint, a fatty substance present in raw wool, is an excellent detergent for wool; in all cases its use results in a higher total yield, with a whiter, softer and more regular sliver and less waste. Wools deprived of their natural fat content by methods of cleansing, e.g., solvent extraction, are improved by washing in a suitable suint. —A.J.H.

(E)—Drying and Conditioning

Drying and Conditioning: Machine for Skeins. *Text. Rec.*, 1926, **43**, No. 515, 95.

A description of the construction of the "Marr" continuous drying machine for skeins. —A.J.H.

Cotton Yarn: Conditioning. *Leipziger. Monats.*, 1925, **40**, 423-424.

A general article on yarn conditioning dealing with the advantages of the enclosed vessel method over the older method of exposing the yarn to the damp atmosphere of a room or cellar. —B.C.I.R.A.

(G)—Bleaching

Fifty Years Progress in Bleaching. M. Fort. *Text. Mfr.*, 1925. Jubilee Number, 1875-1925, pp. 111-115 and 145.

Review of the change and development during the last 50 years in bleaching, laundering, and mercerising. The author points out that the main lines of bleaching treatment have been altered little, although

here and there special chemical treatments have been adopted in practice with success. Mechanical and electrical changes, such as the introduction of electric drives, fans, kier trucks, and rail systems, water-tube boilers, economising superheaters, &c., are the most important developments. Greater changes are visible in linen bleaching than in cotton. Grassing linen is still resorted to, but improved chemical treatment has brought about a large reduction in its use without impairing the quality of the product. Caustic boiling has failed to replace lime boiling in Scotland and Ireland, although caustic soda is largely used on the continent. Improvements have been made in singeing and beetling machinery. Considerable changes are seen in laundering during the last 50 years, some to the detriment of the laundered articles. The modern steam laundry with universal rotary machines, centrifugators, and chemical detergents, has risen to the rank of an important industry. The adoption of the process of mercerising was not secured until the middle of the nineties. Mercerisation has worked a revolution in the cotton trade. Modification of the process as applied to cotton has been found necessary in the case of linen and particularly of damasks, but it can only be a question of time now before mercerised linens are well-known and appreciated generally.

—L.I.R.A.

Sodium Sulphide Solutions on Linen; The Action of——. P. P. Victoroff. *Melliand's Textilberichte*, 1926, **7**, 61-63.

Describes experiments on the loss in weight of linen yarns when boiled with sodium sulphide solutions. The cellulose-content of the yarn employed was previously determined by three different methods. The results obtained suggest that the sodium hydrosulphide produced by the hydrolysis of sodium sulphide is very active in removing non-cellulosic impurities.

—L.I.R.A.

"Blankit": Application. E. Ristenpart. *Leipziger Monats.*, 1925, **40**, 20-21.

Further details of the use of Blankit for improving the white of cotton bleached with hypochlorites. The bleached cotton is rinsed, soured, rinsed, and treated with a solution containing 1 gram of soda and 1 gram of "Blankit" per litre. The best white is obtained by treatment for $\frac{1}{4}$–$\frac{1}{2}$ hour at 90-100° C. At lower temperatures the action must be prolonged. An explanation of the increased strength of cloth treated with Blankit is not yet available.

—B.C.I.R.A.

Modern Methods in Straw Bleaching and Dyeing. C. Williams. *Dyer and Calico Printer*, 1926, **55**, 70-71.

A continuation of previous articles, the properties of vat dyestuffs and their fastness being dealt with.

—A.J.H.

Influence of Scouring on Bleaching. See Section 4B.

Analysis of "Silk" Bleaching Powder. See Section 6.

(H)—Mercerising

Mercerisation; The Determination of the Degree of——. R. Haller. *Melliand's Textilberichte*, 1926, **7**, 65-66.

The author has investigated a series of samples of cotton cloth mercerised with caustic soda solutions of different strengths and dyed with direct dyes. Graphs are given showing the relationship between the concentration of the mercerising solution and the colour of the dyed cloth as determined in accordance with the methods proposed by Ostwald (determination of the proportion of white, black, and full colour). The "black" content increases with increasing concentration of lye up to about 42° Tw. It is suggested that the strength of caustic soda solution used in mercerising could be determined by the use of this method, provided unmercerised material is available for comparison.

—L.I.R.A.

Mercerising Fabric on one Side only. R. Sansone. *Text. Rec.*, 1926, **43**, No. 515, 63.

The first part of an article on the mercerisation of fabrics on one side only for the production of special lustre or colour effects.

—A.J.H.

(I)—Dyeing

Fugitive Dyes in Stripings and Lists. *Wool Record*, 1926, **29**, 23.

Various dyes for fastness of dyes are discussed. For the test for bleeding colour, applied to coloured yarn intended to be used in white or cream goods, a quantity of dyed yarn is plaited with about an equal amount each of cotton, boiled white yarn, and wool, a white scoured sample. This is treated for $\frac{1}{4}$ hour in a 1% soap solution containing 0·05% of soda ash at a temp. of 100° F. Scrub, squeeze, wash, and dry. A comparative test made at the same time with a plait containing standard dyed yarns will reveal the difference in extent of bleeding that has occurred. Fastness of dyed wool to milling is tested by plaiting a sample and treating in 2% soap liquor at 90° F. Scrub and put aside for two hours, press, wash, and dry. For fastness to alkaline milling use 5% of soda with the soap solution at 100° F. Fastness to mineral acids is shown by spotting with 1% sulphuric acid and to organic acids by spotting with 3% acetic acid. Fastness to perspiration, dyed yarn, wool, and cotton should be allowed to remain for 10 minutes. in a $\frac{1}{2}$% solution of neutral acetate of ammonia at 80° F. For testing fastness to mud stains, impregnate the sample with liquor containing 1% of fresh lime at 1%

of ammonia. Squeeze, dry, and brush well. For fastness of dyed wool to seawater, plait a sample with equal amount of white wool, steep in 3% common salt solution for 24 hours and dry. —B.R.A.W. & W.I.

Dyes and their Application: Technical Advances in 1925. *Chemical Age*, 1926, **14**, 5-7.

A review of the technical advances during 1925 in the production and application of dyestuffs. The more outstanding patents in this connection are briefly described. Particular attention is given to the fastness of dyestuffs, which is said to have been the outstanding problem investigated by numerous workers during the year.
—L.I.R.A.

A Light and Water-fast Red and Yellow for Cotton Piece Goods. A. W. *Melliand's Textilberichte*, 1926, **7**, 86 (from *Z. Ges. Text. Ind.*, 1925, **28**, 214).

Dyeings suitable for flags, &c., are obtained by using Diazo Light Scarlet BL with Developer A (Bayer) and Diazo Light Yellow 2G with Developer Z. —L.I.R.A.

Cellulose Acetate Silk: Dyeing. K. H. Meyer. *Melliand's Textilberichte*, 1925, **6**, 737-739.

Experiments on the absorption, from aqueous solutions of varying concentration, of *o*-nitraniline, a typical weak organic base, by cellulose acetate silk have been made. The quantity of nitraniline remaining in solution after equilibrium had been reached, a condition requiring about 14 days, was determined colorimetrically. It was found that the distribution coefficient, Cac. silk/CH_2O, was a constant for all concentrations. The equilibrium, therefore, is not one of adsorption but the dyestuff is in "solution" in the fibre, and this conception is confirmed by the uniformly dyed appearance of sections of dyed fibre. Nitraniline could not be displaced from acetate silk by tetralin, in which it is very soluble, and the silk remained colourless in solutions of *o*-nitraniline in tetralin. Dyeing or stripping occurred only in the presence of water, the function of which is not understood. In dyeing with basic dyes the process is otherwise. Sections show that dyes such as Methylene Blue are fixed on the surface of the fibre only. In the presence of a suitable mordant, the mordant forms with the basic dye a salt or salt-like compound which is soluble in ethyl acetate and similar solvents. The salt is probably dissolved in the fibre whilst surface coating also occurs. The processes of solution and adsorption occur one upon the other and it is thought probable that the complicated dyeing relations of other fibres may be similarly traced to the occurrence, one upon another, of different processes. —B.C.I.R.A.

Turkey Red Oils: Constitution. — Sprenger. *Melliand's Textilberichte*, 1925, **6**, 585-586.

Conceptions of the constitution of Turkey red oils are discussed. That of Juillard, according to which Turkey red oils contain the sulphuric acid ester and glycerol sulphuric acid ester of ricinoleic acid and several polyricinoleic acids, as well as their decomposition products, is supported. According to the method of preparation a whole series of Turkey red oils can be obtained varying in composition and properties, and co-operation between the maker and textile consumer is advocated in order that the best oil for each individual purpose may be ascertained and supplied.
—B.C.I.R.A.

Dyes: Fastness to Light. W. Heinisch. *Leipziger Monats.*, 1925, **40**, 174-175.

A means of judging fastness to light of dyestuffs based on the time of fading on exposure to light. Wool yarn which has been bleached with hydrogen peroxide and dyed with 0·1% of Indigotin I—which dyeing constitutes an *Echtheitskommission* type of (low) standard fastness to light—is used as the standard. The dyed yarn is wound on a cardboard strip so that the strands lie side by side; half the yarn is covered by a second strip of cardboard and the whole exposed to light until the colour disappears. A number of these standards is required. In testing the fastness of a given dyeing a sample of the same yarn is dyed to the same depth of colour as the standard, wound in the same way and exposed to light side by side with the standard under the same conditions. As soon as the standard has faded it is replaced by a second and so on until the dye under test has faded. A sample dyeing which outlasts three standards is said to have a resistance to light action of the third degree. —B.C.I.R.A.

Artificial Silk: Dyeing. E. Greenhalgh. *Dyer and Calico Printer*, 1926, **55**, 72-73.

A continuation of previous articles, particular attention being paid to the dyeing of viscose and cellulose acetate yarn. The surface of viscose yarn is likely to crack and thereby become harsh when dried too vigorously. Subsequent winding of dyed viscose yarn is improved if the yarn is impregnated with a lubricant such as Turkey Red oil or Monopol soap. —A.J.H.

Vat Dyes on Wool. C. A. Seibert. *Dyer and Calico Printer*, 1926, **55**, 74-75.

Wool may be dyed with vat colours by means of dye liquors prepared with glue, ammonia (instead of caustic soda), and sodium hydrosulphite without depreciation in handle. The fastness of the resulting dyeings is generally excellent and superior to that obtained by means of chrome mordant and after-chrome colours.
—A.J.H.

Dyes: Fastness. P. Krais and A. Kertess. *Leipziger Monats.*, 1925, **40**, 93-95.

The authors in discussing the popular idea of the fastness of colours call attention to the work of the *Echtheitskommission* set up by the Textile Section of the Verein Deutscher Chemiker. The *Kommission* published in 1914 a detailed scheme by which the fastness qualities of a particular dyeing on cotton or wool towards light, washing, &c., are expressed not in terms of the particular class of dyestuff but as an arbitrary series I. to VIII. of increasing degree of fastness. For example, cotton dyed with 25% Indanthrene Blue G.C. (No. 843 in Schultz's Tabellen) had a (maximum) fastness to light of VIII. The standard series I.-V. is adequate for expressing degree of fastness towards factors other than light. —B.C.I.R.A.

Preparing Cotton Fabrics for Dyeing. H. C. Roberts. *Dyer and Calico Printer*. 1926, **55**, 96-97.

Some padding machines suitable for use in impregnating cotton fabrics with desizing liquors, e.g., malt extracts, are described. —A.J.H.

Dyeing Mixed Goods containing Celanese: Cellulose-acetate. F. M. Stevenson. *Dyer and Calico Printer*, 1926, **55**, 86-88.

In scouring Celanese before dyeing, the temperature and composition of the scouring bath must be carefully selected since organic solvents such as acetone and tetrachlorethane dissolve, boiling liquors except in the presence of considerable quantities of neutral salts de-lustre, and small quantities of alkalis hydrolyse Celanese. Celanese may now be dyed in all shades by means of dyestuffs which are usually applied in colloidal solution. Solid black shades on cotton-Celanese union fabric are obtained with developed colours, development being carried out at 60° C. Sulphur colours may be dyed on Celanese by a modification of the Lodge-Evans process for wool. In dyeing with vat dyestuffs from alkaline baths, the Celanese is protected from hydrolysis by the addition of such phenolic bodies as phenol, β-naphthol, resorcinol, &c. Wool-Celanese and silk-Celanese union materials are dyed in two colours by means of cellulose acetate dyestuffs and acid dyes (for the animal fibre). S.R.A. dyes do not stain silk so much as they do wool. —A.J.H.

Causes of Dichroism of Dyed Fibres. See Section Ic.

Modern Methods in Dyeing. See Section 4G.

Becke's Colour Theory. See Section 6.

Tendering of Dyed Fabrics. See Section 6.

(J)—Printing

Developments in Calico Printing. R. Sansone. *Dyer and Calico Printer*, 1926, **55**, 90-91.

A continuation of previous articles, machinery and methods for mordanting cotton fabric rapidly with tannic acid and tartar emetic being described. —A.J.H.

(K)—Finishing

Pasting Cloth; Adhesives for——. W. B. Nelson, *Text. Mfr.*, 1926, **52**, 30-31.

Describes a machine suitable for superimposing one fabric on another and pasting them together. Recipes for suitable pastes are given. —L.I.R.A.

Rubbered Silk Fabrics. *Silk Jl.*, 1925, **2**, No. 18, p. 57.

Rubber covered silk can now be obtained in all art shades. The cloths are very light; a coated crêpe de chine consisting of 34% silk and 66% rubber and weighing only 4 oz. to the square yard is an example of this. The future for such materials promises to be phenomenal. —F.G.P.

Matt Artificial Silk Fabric. W. Bruckhaus. *Kunstseide*, 1925, **7**, 260-261.

A process for diminishing the lustre of artificial silk consists in precipitating barium sulphate on to the fabric. This is soaked in a warm bath containing 2-3% of sulphuric acid and then transferred without rinsing to a bath of 3-5% barium chloride solution at 70°. The precipitation of barium sulphate on the fabric should be complete in 20-30 minutes. The loaded fabric can then be dyed without losing its matt appearance provided that the dye bath is free from Glauber or other salts. The increase in weight of the fabric amounts to 3-5% of the original weight. —B.C.I.R.A.

Patents

Cotton and Artificial Silk: Dyeing. Maschinenbau-Anstalt Humboldt. D.R.P. 413,239 (from *Chem. Zentr.*, 1925, **ii.**, 351).

Black colours on cotton or artificial silk are obtained by treating animal or vegetable charcoal obtained by careful preparation at the lowest possible temperature with heavy metal salts in the colloid mill in the presence of synthetic or natural tanning materials. If lamp black, tannin, gallic acid and water are ground in the mill and a solution of ferrous sulphate in water is added with subsequent grinding, the resulting paste can be used either for dyeing in the dye bath or for colour printing. The ink-yielding compounds act as dispersion accelerators of the charcoal and facilitate dyeing by forming with the salts of the heavy metals coloured compounds of a colloidal nature. —B.C.I.R.A.

Fast Colours; Application of——. G. J. and G. B. Mess. U.S.P.1,486,353 (from *Chem. Abstr.*, 1924, **18**, 1576).

Colours such as Indanthrene Blue or Algol Red are applied to cotton or other cloth and the material is then passed through hot caustic soda, is submerged in cold

caustic soda, washed in cold running water, and finally "subjected to a cold water bath containing sulphuric acid" to fix the colour.
—B.C.I.R.A.

Textile Fabrics: Waterproofing. A. H. Penfield. U.S.P.1,549,798 (from *Text. World*, 1925, **68**, 3545).

Waterproof fabrics are obtained by treating the yarns with a solution of aluminium acetate through which an electric current passes. By treating the yarns instead of the woven cloth the width and weight, as well as colour and shade are fixed.
—B.C.I.R.A.

Dyestuff Emulsions: Preparation. C. E. J. Goedecke and Colloisil Colour Co. E.P. 241,331.

Colloidal solutions or emulsions of dyestuffs suitable for use in calico printing or lake making, are prepared by mechanically working together a dyestuff, a solvent for the dye in sufficient quantity to dissolve the whole of the dye, and a third material which does not form a lake with the dye, but transforms the whole into a colloidal solution or emulsion. Such materials are oil, fat, mineral oil, waterglass, soap, dextrin, starch, and glue or mixtures thereof, whilst suitable solvents are water, acids, alkalis, or alcohols, depending on the type of dyestuff. The emulsions produced may be worked with substrata such as green earth or white earth to produce lakes. Some examples are given.
—B.C.I.R.A.

Fabric Damping Apparatus. J. Charlesworth, Huddersfield. E.P.242,017.

In apparatus for damping fabrics the rotary member from which the spray originates and which, for this purpose, dips into water contained in a trough, is provided with a series of perforated and corrugated or wavy discs from the edges of which the spray is thrown off. The peripheral edges of the disc are preferably tapered to a knife edge. The mouth through which the spray passes to the fabric is formed by two plates, one of which is movable for the purpose of adjusting the width of the mouth. The spray is thrown on to a deflector arranged below a wire-gauze screen provided to break up any large particles and a further diffusion of the spray is obtained by air jets directed across the rear of the screen. The fabric to be treated passes first over a steaming chest and, after damping, is carried by rollers to a cuttling-arm.
—B.C.I.R.A.

Propyl- and Butyl-naphthalene Sulphonates: Application. Badische Anilin-and Soda-Fabrik, Ludwigshafen-on-Rhine, Germany. E.P.242,233.

Uniform dyeings of great fastness to rubbing are obtained by adding to the dyebath, or by previously wetting the fibre with propylated or butylated aromatic sulphonic acids or their salts or such derivatives of other cyclic hydrocarbons, with or without the presence of aliphatic, especially the higher aliphatic, alcohols. A dyebath for raw unboiled cotton yarn comprises Indanthrene Blue GCD, caustic soda, sodium hydrosulphite, and sodium butyl naphthalene sulphonate, and a second dyebath for cotton yarn comprises Oxamine Blue A, Glauber's salt, and sodium isopropylnaphthalene sulphonic acid. The above sulphonic acids may also be used in developing dyestuffs on the fibre.
—B.C.I.R.A.

Viscose Artificial Silk: Waterproofing. H. Hawlik, Gneisenaustrasse, Berlin. E.P. 242,240.

Viscose filaments, films, &c., are rendered resistant to water by forming with the filament, &c., during spinning suitable waterproofing substances. For example, a soluble salt of a base is incorporated in the viscose solution and in the spinning bath an organic acid which will form with the base an insoluble waterproofing compound. Alternatively, the acid may be added to the viscose solution and the salt to the spinning bath. Suitable salts are sodium aluminate, aluminium chloride, sulphate, and acetate, and salts of calcium, barium, strontium, tin, and zinc, or mixtures of these. The acids employed may be the higher fatty acids such as palmitic, stearic, oleic, erucic, and sulphoricinoleic acid, the hardened fatty acids, hydroxysebacic acid, halogenated fatty acids, resinic acids, and wax acids, and with them may be mixed "aromatic acids," such as salicylic and tannic acids, or the soaps of these acids may be used.
—B.C.I.R.A.

Cellulose Acetate: Dyeing. British Celanese, Ltd., London, and G. H. Ellis, Spondon, near Derby. E.P.242,393.

Instead of the solubilising agents described in Specification 219,349, sulphoaromatic fatty acids, such as sulphobenzene stearic acid, or their derivatives, such as sulpho-phenol stearic acid or sulphonaphthalene stearic acid, or salts of these acids are employed. In addition to the dyestuffs or components described in the parent specification, those specified in Specifications 224,681, 227,183, and 237,943 or other insoluble or relatively insoluble dyestuffs or compounds may be used. Examples of the preparation of the solubilising agents and of the production of various colours are given. —B.C.I.R.A.

Imitation Leather Fabric: Preparation. H. F. V. Meurling, Helsingborg, Sweden. E.P.242,537.

A fabric having a surface resembling that of finely tanned skin or leather is obtained by impregnating a textile, such as cotton flannel, with a solution of rubber in benzole or other solvent to which talc, or magnesium, aluminium, or zinc oxide has been

added, treating the impregnated product with alcohol and subjecting it to pressure, grinding, and polishing. This treatment may precede the treatment with alcohol. Colouring matter may be added to the alcohol. The fabric is allowed to dry both after impregnation and after the treatment with alcohol. The coating operation may be repeated two or more times.

—B.C.I.R.A.

Cellulose Acetate: Dyeing. British Celanese Ltd., London, and G. H. Ellis and W. O. Goldthorpe, Spondon, Derbyshire. E.P. 242,711.

In the dyeing, printing or stencilling of yarns, fabrics, or other products of cellulose acetate or of mixed goods containing it, by means of insoluble or relatively insoluble colouring matters or organic compounds (for the production of dyes on the material), there are employed in conjunction with the solubilising agents named in Specification 219,349 the following secondary or auxiliary solvents—alkyl or alkylene halides such as tetrachlorethane or trichlorethylene, simple or mixed cyclic or aromatic derivatives containing one or more amino, chlor or hydroxy groups such as cresols, alkylanilines, toluidines, chlorophenols or mono or poly-chlorobenzenes, and hydrogenated derivatives of such or other aromatic compounds, for example, hexahydrophenol, with resultant economy both in the amount of solubilising agent and of dyestuff necessary. Suitable substances are indicated. —B.C.I.R.A.

Tubular Fabric Stretching Frame. T. Geeson, Macclesfield, Cheshire. E.P. 242,734.

A tubular fabric is fed by rollers and side pulleys over a tubular frame at the same rate as or faster than it is taken up by a second pair of rollers, "bowing" of the fabric being prevented by eliminating resistance at the sides of the frame by the use of anti-friction wheels and by retarding the fabric at the centre by means of curved inclined bars and straight bars. The fabric passes over steaming troughs and a drier, preferably heated by steam pipes, before it reaches the take-up rollers and may then pass between hot or cold calendering rolls. The delivery end of the frame is square and is fitted with a thin plate projecting between the take-up rollers. The straight bars are carried in holes in swivelling brackets. The two steaming troughs are fitted with sliding shutters and the side pulleys are adjustable to suit frames of different sizes. —B.C.I.R.A.

Drying and Lustring Machine. Calico Printers' Association, Ltd., and F. Farnworth, Manchester. E.P.242,749.

In machines for drying fabrics in which the fabric passes round inter-geared drying drums, friction rollers or endless blankets are disposed adjacent a number of the drums at the delivery end of the machine and act on the fabric as it passes over the drums. The blankets are brought into contact with the fabric to work up the pattern and impart lustre to the fabric. The tension of the blankets is adjusted by jockey rollers and they are arranged in frames movable towards the drums with which they co-operate. The friction rollers or blankets may be driven at any desired speed relative to that of the fabric and the drums may be driven by the fabric. Heated polished stationary rolls and means for supplying finishing materials such as wax, oil, &c., may be provided. The friction rollers or blankets may be arranged to travel to and fro across the fabric. —B.C.I.R.A.

Jigger Dyeing Machine Guide Rollers. J. Dean, Toller Lane, Bradford. E.P. 242,790.

In a dyeing machine in which the material is drawn from a beam through a vat and through nip rollers to a second beam and *vice versa*, one or more guide rollers are adapted to be moved into and out of the vat to either side of the nip rollers to give immersion to the material in either direction of its travel, only the immersed roller contacting with the material. The material is drawn over a heating element and through a small movable vat in which it is guided by a fixed roller and two movable rollers which are mounted in a vertically movable frame or fork. When movement of the material in one direction is completed, the vat is moved to the other side of the nip rollers where similar rollers are lowered into it, the arrangement making re-threading of the material between the rollers unnecessary. A single large vat may replace the movable vat.

—B.C.I.R.A.

Dyeing Circulatory Machine. J. Schlumpf, Oberwinterthur, Switzerland. E.P. 242,857.

In machines for dyeing, &c., the material, such as skeins of yarn, is placed in two chambers which are interconnected at their upper ends by pipes and are connected at their lower ends by other pipes to a four-way valve having an outlet in communication with the output and intake sides of a pump so that liquor may be circulated up either chamber and down the other. Meanwhile, the upward flow of the liquid, which might cause entanglement of the fibres under treatment, is moderated by providing a single bye-pass pipe leading directly from the output side of the pump to the junction of the upper pipes. The single bye-pass pipe may control more than one pair of chambers.

—B.C.I.R.A.

Dyeing Machine. E. Cadgene, New Jersey, U.S.A. E.P.242,936.

A dyeing machine comprises a rotating reel over which a number of lengths of fabric are passed, and a pair of guiding devices, the

lengths which pass around one guiding device being arranged in staggered relation to the lengths passing round the other device. —B.C.I.R.A.

Cloth Guide Rollers. J. J. Lyth, Quebec, Canada. E.P.242,954.

Guide rollers for feeding cloth impregnated with corrosive or other liquids to bleaching and finishing apparatus, winding drums, gear wheels, &c., are built up with separated spiders, each formed in two or more parts bolted on the central shaft. The spokes are connected in pairs by webs and are shaped at their outer ends to grasp separate guide blocks, gear teeth, &c., which are secured in position by bolts connecting the spiders. By substituting bolts of different lengths, blocks of varying size and shape may be built into the wheel. —B.C.I.R.A.

Cellulose Acetate Varnishes: Preparation. A. Eichengrün, Charlottenburg, Berlin. E.P.243,031.

Coating compositions for fabrics, fibrous or solid materials, comprise solutions of acetone-soluble cellulose acetate, or a mixture of acetone-soluble and chloroform-soluble cellulose acetate, formed in the cold by solution in methylene chloride, together with methyl alcohol or its homologues, or a solvent or mixture of a solvent and a non-solvent for cellulose acetate or a mixture of two non-solvents which together form a solvent for cellulose acetate. The methylene chloride, with or without the specified additions, may be added to a solution of cellulose acetate. The solutions obtained are quick-drying and substantially non-inflammable. When methyl alcohol is added, the preferred proportions are 20% of alcohol and 80 % of methylene chloride, but the alcohol percentage may vary from 5-45%. Other specified added solvents, non-solvents, &c., are acetone, formic and acetic esters, benzene, ethylene chloride and triacetin. Fillers, softening agents, high-boiling or solid chemical products may be added. The compositions may be applied over nitrocellulose coatings.

—B.C.I.R.A.

Circulating Kier. P. F. Haddock, Charlotte, N.C., U.S.A. E.P.243,262.

A kier comprises a shell containing a perforated false bottom, adapted to support the material to be treated above a well into which liquor from the material drains, and a circulation system which causes liquor to be forced upwards centrally of the mass of the material and to be discharged on top of it. The kier has an openwork cage extending above the false bottom and within the mass, and through its openings the liquor from the material drains transversely into the central rising column. To cause the circulation, steam blown through an adjustable nozzle draws liquor up a central pipe the lower end of which is adjustably arranged within the cage. The raised liquor is ejected through holes in the top of the pipe. Two modifications are described. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Scouring—

243,030. A. Eichengrün. Solvent for fats and alkaloids.

Bleaching—

242,805. A. Lamble and United Alkali Ltd. Stabilisation of bleaching powder.

Dyeing—

242,027. S. W. Wilkinson. Dyeing process for silk, wool, fur, &c.

Finishing—

242,491. H. D. Fitzpatrick. Calender roller adjustment device.

5—LAUNDERING AND DRY CLEANING

Preparation of Complete Soaps. F. Ortner. *Seifensieder Zeitung*, 1925, **52**, 635.

Comments on preparation of a soap powder containing perborate and on recent D.R.P. 415,124. Preparation of Persil is described—350 kg. and soap powder dipped (or sprinkled) with 100 kg. sodium silicate solution. The covering of sodium silicate hinders the action of the perborate on the soap particles and also protects the soap against hard water. Final Mixture: 450 kgm. soap-sodium silicate mixture; 450 kgm. fat free detergent; and 100 kg. sodium perborate. —B.L.R.A.

New Soap Acid: Pflanzenölfettsäure "H." *Seifensieder Zeitung*, 1925, **52**, 643.

A new "soap oil"—Pflanzenölfettsäure "H"—light in colour and considerably cheaper than the others. Acid number 132, saponification number 180, unsaponifiable 7·5%. Soap made from acid "H" alone is, according to Knigge, a soft soap; mixed with 20% tallow, 20% coco-oil gives curd soap. —B.L.R.A.

Patents

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Laundering—

242,786. D. K. Tullis. Washing machine with rotary receptacle.

242,283. A. F. Dunsmore. Washing machine: drive control.

242,285. J. W. Thompson. Washing machine with axially moving plungers.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Cotton Cloth: Effect of Heat. F. Driessen. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 475-478.

A piece of cloth which, owing to an accident, was left for some time in the drying-room above a calico printing machine and became excessively dry, appeared to be badly tendered, but on testing it in a Schopper tester it gave a normal result. Tests were therefore made in which the dynamometer was placed within the drying-room just beneath the roof, where a temperature of 85°-90° prevails. Under these conditions the test pieces of cloth contain very little moisture. Numerous tests made on a white fabric over a considerable range of temperature show that the strength of a fabric varies considerably with humidity and temperature. A fabric with a breaking load of 18 kg. in dry surroundings at a temperature of 85° has a breaking load of 31 kg. in a humid atmosphere and at a temperature of 4°. Some experiments have also been made on the behaviour of strips of fabric soaked in liquids other than water, which form no combination with cellulose, as, for example, alcohol, benzene, &c. No results are recorded. —B.C.I.R.A.

Ostwald's Colour Theory and Its Use in the Textile Industry. E. Ristenpart. *Leipziger Monats.*, 1925, **40**, 484-491.

In this part of the article the Ostwald half shadow photometer and the Pulfrich stage photometer are described and illustrated. A review is then given of the extensive practical applications of Ostwald's theory. The measurement of grey colours with the half shadow photometer depends on comparison of the grey to be measured with a standard full-white. The intensity of illumination of the full white is reduced by an adjustable aperture till the white appears of the same intensity as the grey. The width of the aperture indicates the proportion of white light in the grey colour. The instrument can also be used for the measurement of lustre. The Pulfrich stage photometer represents an improvement on the Ostwald photometer. It is capable of complete measurement of colour. With this apparatus, two parallel tubes focus on an objective table. The light on the two is collected by prisms to be viewed by a single ocular. One tube contains a fixed and the other an adjustable aperture. Equal intensity of lighting of the objects to be viewed is attained by exposing two normal white plates to daylight, and setting the instrument so that with the adjustable aperture fully opened there is equal intensity in the two half circles viewed by the eyepiece. The proportion of white in a grey colour is then determined as with the Ostwald photometer. The tinted colours are evaluated in accordance with the principle of Ostwald's theory, that is, by finding that tint in the colour circle which, on combination with the unknown colour, gives a neutral grey. The proportions of black and white are determined with the use of filters. —L.I.R.A.

Mullen Paper Tester: Application. R. Sieber. *Papier-Fabr.*, 1925, **23** (Verein Zellstoff Ingenieure Section), 617-618.

A discussion of the relative merits of the Mullen paper tester and the Schopper tester. The author points out that the former measures the tensile strength of paper in an area, i.e., in two dimensions, and he is inclined to think that the Mullen tester gives better results, particularly for certain types of paper, than the Schopper tester. He calls attention to Bergman's fundamental work on the tensile strength of wood cellulose, which has apparently been overlooked when the practicability of the Mullen tester has been examined, and in which is employed a formula which takes into account surface forces. Tables are given showing the observed values and those calculated according to Bergman's formula for laboratory papers and for machine made papers. In general the calculated values are somewhat too high. —B.C.I.R.A.

Mullen Tester: Application. A. Abrams. *Papier-fabrikant*, 1925, **23**, 732 (from *Paper Trade J.*, 1925, **81**, 56-59).

The following results were obtained in an investigation of the optimum conditions of use of the Mullen tester and the Jumbo Mullen tester. The maximum Mullen test value is obtained at approximately 35%-45% relative humidity, or a moisture content of 4%-8% in the paper. The test piece should be 30 by 30 cm., and six experiments, three in each direction of the sheet, should be made. The results should deviate not more than 3% from the average. Both types of apparatus give results differing by about 14%, according as the test piece is tightly or loosely tensioned. The mean values obtained by two workers working under the same experimental conditions should not vary by more than 2. The Mullen value falls as the bursting surface is increased. The results may be as much as 14% too low if an old diaphragm is used. Comparable, reliable results are only obtained under uniform experimental conditions. The apparatus must be kept filled with glycerol, the diaphragm must not be too old, and the clamps must be accurately adjusted. The test piece must be under a definite tension in the clips. —B.C.I.R.A.

Detection of Methylhexaline in Textile Oils. J. Marcusson. *Analyst*, 1925, **50**, 524 (from *Chem. Zeit.*, 1925, **49**, 656).

Hexaline (hydrogenated phenol) and methylhexaline (hydrogenated cresol) are

now incorporated, together with hydrocarbons, in some textile soaps. For the detection of hexaline or methylhexaline in the presence of tetraline, trichlorethylene, and alcohol in the soap or an oil, about 150 grams are acidified, then steam-distilled, until the hydrocarbons and phenols have all passed over; then the distillate is shaken out with alkali to remove any fatty acids which have come over, and the residual oil is separated. This residue is benzoylated by heating with benzoyl chloride under a reflux condenser for about a quarter of an hour. Hydrocarbons are separated from the benzoyl ester by distillation with steam, and the residue, after all hydrocarbons have been removed, is extracted with ether, washed, and dried. The benzoyl esters are recognised in the ordinary way; they are both denser than water and have refractive indices 1·5103 and 1·5108 for hexaline and methylhexaline respectively (temperature not stated). One per cent. of hexaline can be detected in this way. —L.I.R.A.

Viscosimetry; Methods of——. W. Stauf. *Kolloid Zeits.*, 1925, **37**, 397-405.

This paper is divided into two headings, theoretical and practical. Attention is drawn to the difference in magnitude of the temperature coefficients for the viscosity of homogeneous and non-homogeneous liquids. Colloids are specially mentioned as showing great difference in viscosity under varying conditions. Limitations of the Hagen-Poiseuille law are stated, and equations are given which may be used to determine suitable dimensions of instruments and limiting velocities of flow of liquids, using a U-tube type of instrument. A difference exists between the behaviour of liquids as regards limiting velocity for slow out-flow, depending on whether the instrument used is a straight capillary or a U-tube type. For velocities of flow above the limit for the H.P. law the anomalous behaviour of colloidal solutions is important, and has been attributed by Hass and others to shear-elasticity of adjacent colloid particles. Ostwald, however, attributes it to the presence of actual mechanical structures in the dispersed system. He also found that a very slight alteration in the Hagen-Poiseuille law gave an equation representing the relation of velocity to pressure in such a system for low speeds of flow. A detailed description with diagrams of various types of apparatus is given with a discussion of their suitability for the determination of the velocity function, which is important, especially in the case of certain colloids, where tests are necessary to determine whether their behaviour is anomalous or not. The following types of viscometers are described—Four capillary instruments, a torsion viscometer, and a less accurate instrument, the technical viscometer of Engler. —L.I.R.A.

Vegetable Colouring Matters: Fluorescence. L. Meunier and A. Bonnet. *Compt. rend.* 1925, **181**, 465-467.

Morin, quercetin, rhamnetin, and luteolin, although of the same general structure as fisetin, are not fluorescent. Acetylation of the hydroxyl groups in fisetin removes the fluorescence, which is recovered on hydrolysis. Plant extracts containing berberine possess a yellow fluorescence, which is also given by the alkaloid adsorbed on filter paper, cotton, viscose, and nitro-cellulose. Berberine gives lakes with tannins or with fisetin which are not fluorescent in spite of the fluorescence of the components. Precipitation of fisetin and berberine by potassium mercury iodide, &c., results in the disappearance of the fluorescence from both precipitate and supernatant liquid. Extracts of turmeric, anatto wood, logwood, and saffron are not fluorescent; alkanet roots and orchil exhibit a white fluorescence. These properties are of value in the identification of commercial wood extracts. —B.C.I.R.A.

Olein: Testing. C. Stiepel. *Chem. Zentr.*, 1925, **ii.**, 991-992 (from *Z. Dtsch. Ol-u Fettind.*, 1925, **45**, 217-219).

The following constants are proposed for true "textile olein"—D^{20}=0·899-0·904; open flash point 180-190°; viscosity ·7 measured in an Engler viscosimeter according to Mackey's method at a temperature of 100°. Practically none of the olein substitutes possesses all the above properties. Determination of the iodine value is not applicable since it indicates the quantity of the liquid and not of the unsaturated fatty acids. Steam distillation at about 220° throws light on the low fatty acid iodine value. If the olein is subjected to fractional crystallisation there remains a liquid fatty acid, from the iodine value and viscosity of which a deduction can be drawn as to the character of the olein. If polymerised liquid fatty acids are present in it the viscosity is high and the iodine value increases on treatment with fullers earth. —B.C.I.R.A.

Malt Extract: Diastatic Power. F. Ducháček and Zila. *Chem. Zentr.*, 1925, **ii.**, 249-250 (from *Woch. Brau.*, 1925, **42**, 77-78, 81-83, and 87-89).

After discussing the action of diastatic malt-extract in desizing in which process more value is to be placed on its liquefying than on its saccharifying powers, the authors compare the methods of Pollak and of Windisch and Kolbach for estimating the saccharifying power. For accurate determinations Pollak's method was found to be unsuitable; it gave values 25 times as high as those obtained by Windisch's method, mainly because of different experimental conditions and the employment in Pollak's method of arrowroot starch instead of soluble starch. The authors employ the Windisch method with the exception that

the temperature is changed to 37·5° (the optimum for malt diastase); 1% solutions of extract are taken in every case. Oxidation of the maltose formed with hypoiodite should result in 30 mins. at 20°; the activity is calculated on 1,000 grams of extract. The activity of malt diastase increases with increasing dilution. —B.C.I.R.A.

Malt Extract: Diastatic Power. W. Windisch and P. Kolbach. *Chem. Zentr.*, 1925, ii., 1396 (from *Woch. Brau.*, 1925, **42**, 139-141).

In view of recent determinations of the diastatic activity of malt extracts (above), the authors have modified in some particulars their original method (see *Chem. Zentr.*, 1923, ii., 46; from *Woch. Brau.*, 1922, **39**, 213). The modified method is described in detail. —B.C.I.R.A.

Sodium Hydrosulphite: Estimation. W. Heinisch. *Leipziger Monats.*, 1925, **40**, 173.

The strength of a sample of sodium hydrosulphite may be conveniently determined by its reducing action on potassium ferricyanide. One or two drops of freshly prepared ferrous sulphate solution as indicator are added to an accurately measured quantity (20 ccm.) of potassium ferricyanide solution until there is a faint blue coloration but no precipitate. Sodium hydrosulphite from a known quantity contained in a weighing bottle is added until the blue colour changes through green to yellow when the end point is reached. By weighing the hydrosulphite remaining in the weighing bottle the weight of hydrosulphite added is known. The standard solution of potassium ferricyanide is made by dissolving 32·9 grams of chemically pure potassium ferricyanide in one litre of water; 1 ccm. of this solution =8·7 mg. of $Na_2S_2O_4$. —B.C.I.R.A.

Naumann-Schopper Cardboard Flexibility Tester. M. Naumann. *Zellstoff u. Papier*, 1925, **5**, 437-439.

The instrument, which is designed specially to measure the flexibility of cardboard, is described in detail. It differs from the corresponding paper tester, which measures folding strength, in the method of applying the load. The curves obtained for cardboard show initially a rough proportionality between breaking load and angle of curvature. —B.C.I.R.A.

Aktivin: Estimation. P. Krais and W. Meves. *Melliand's Textilberichte*, 1925, **6**, 608.

A simple method of estimating the Aktivin content of solutions when it occurs in low concentrations as in bleaching and washing liquors, is based on its power of decolorising indigo. The test is made in a specially graduated stoppered cylinder. The solution to be tested is poured in, to a given mark, and concentrated hydrochloric acid is first added to a second mark then indigo, in solution in concentrated sulphuric acid, to a third mark. The whole is then well shaken. Indigo solution is thereafter added in small amounts until a bluish-green colour persists in the solution. The percentage of Aktivin in the original solution is read direct from the cylinder. The specially graduated cylinder and the indigo solution are furnished by the makers of Aktivin. —B.C.I.R.A.

Neutral Point Indicator. G. Chabot. *Chem. Zentr.*, 1925, ii., 1375 (from *Bull. Soc. Chim. Belg.*, 1925, **34**, 202-211).

A method of titrating solutions at exact neutrality (pH=7·07) employs as indicator equal volumes of Phenol Red and Cresol Red in alcoholic solution and allows of accurate determination of the neutralisation point in ordinary methods of titration as well as with the Walpole comparator. The solution must be titrated hot because of the sensitivity of the indicator to carbon dioxide. —B.C.I.R.A.

Artificial Silks: Identification. K. Götze. *Melliand's Textilberichte*, 1925, **6**, 769-770.

Some general tests for the identification of the different types of artificial silk are outlined and a test for viscose silk in which the silk is heated with a 1% ammoniacal silver nitrate solution is described. Viscose silk shows a distinct brown colour. Under the same conditions cuprammonium silk remains colourless so that the test forms a rapid means of distinguishing the two types. Nitro-silk also gives a brown colour but can be readily confirmed by the diphenylamine test. The brown colour is traced to the deposition of finely divided metallic silver on the fibre. —B.C.I.R.A.

Adhesives: Description. G. M. Dyson. *Chem. Age*, 1925, **13**, 488-490.

In a survey of adhesive substances the author describes the preparation and properties of hide, bone, and fish glues and the tests to be applied to commercial samples. The paper concludes with notes on the preparation of casein and casein adhesives, on gum tragacanth and on the different varieties of gum acacia. —B.C.I.R.A.

Cuprammonium Silk: Breaking Load. Brysilka, Ltd. *Silk J.*, 1925, **2**, No. 17, p. 39.

Certain criticisms by the British makers of cuprammonium silk of the results obtained by the Bureau of Standards in their investigation of rayon, mainly as regards denier and number of filaments, covering power, and tensile strength of filaments. A table of filament number and breaking load data for three cuprammonium silks (Bemberg, Brysilka, and Hölken), made by the stretch process is given. —B.C.I.R.A.

Cellulose Acetate Silk: Identification. *Silk J.*, 1925, **2**, No. 16, p. 56.

A sample of cellulose acetate silk can sometimes be identified by treatment with a drop of acetone which causes softening or solution of acetate silk, but has no effect on viscose. —B.C.I.R.A.

Brazilian Cotton: Grading. *Cotton* (M/cr.), 1925, **31**, No. 1492, p. 10.

A new basis of classification, which has been established in Brazil, is compared with the standards previously in force, to the following effect—

New type 1 is equal to the old "la special."
New type 3 is equal to the old "la."
New type 5 is a little better than "medium good."
New type 7 is somewhat better than "common average."
New type 9 is rather better than the "old low average."

It has been resolved to make these standards permanent. —B.C.I.R.A.

Cotton Staple Standards: U.S.A. *Text. Merc.*, 1925, **73**, 356.

It has been decided to issue practical forms for 17 lengths of staple in American Upland cotton, varying from $\frac{3}{4}$ in. to $1\frac{1}{2}$ in. and four lengths of American Egyptian cotton, varying from $1\frac{1}{2}$ to $1\frac{3}{4}$ in. The range now includes types not previously represented. —B.C.I.R.A.

Reed Marks and other Warp Stripes. H. Priestman. *Wool Record*, 1926, **29**, 26.

To clear up the many opinions which exist regarding the effect of moisture on the number of picks per inch which can be inserted into any given warp, the writer has woven alternate spools of yarn. (1) Taken straight from the frame, (2) dipped in water, (3) adjacent to bobbins in ordinary trade condition. With 13 times the proper amount of water in yarn, the picks in any given cloth may be increased by about 10%, but yarn differing by about 5% showed no difference in the number of picks per inch. Reed marks show where there is as little variation as 5% in the number of threads between any two adjacent quarter inches, but cannot necessarily be detected, if it is once removed from the loom. The way in which the yarn will be affected in a false reed mark depends on the extent to which the false reed crosses the fixed reed. Excessive tension to a narrow group of ends in the warping process, can produce marks resembling reed marks.

The writer has had warps prepared for purpose of experiments. The first test shows that when a group of ends in a warp 90 in. long, were extended by 3 in., a mark was made, in which the difference in the number of threads per inch reached as much as 1·67%. Considering that 2 lb. 6 oz. must be added to a group of 15 ends to produce this extension, faults in the warping are impossible in which ends are moved sideways as much as 10%. In the second test by adding 1 lb. 8 oz. to 15 threads, a stretching of 1·25 in. took place in 90 in., and in 300 mm. of cloth the normal take-up was 356·9 mm., in the stripe 352·9 mm. The third test was made by stretching 33 threads 1 in. in 90 in., by adding 3 lb. 9 oz. to the normal strain on the warp in weaving. Four square half inches were stamped out from the stripe and the adjacent cloth. The average number of threads was 34·375 in the normal and 35 in the stripe, which shows that stretching of any group of threads does make them lie closer and therefore produces the same kind of mark, which would result from a slightly damaged reed. —B.R.A.W. & W.I.

Surface Tension in Textile Treatment. J. R. Booer. *Dyer and Calico Printer*, 1926, **55**, 92-93.

A simple form of apparatus, Traube's stalagmometer, for measuring surface tension is described, and suggestions are made for its use in comparing the penetrating power of dye liquors containing colour solvents. —A.J.H.

Fabrics; Some Effects of Humidity on——. R. G. Parker and D. N. Jackman. *Text. Mfr.*, 1926, **52**, 28-30.

Working with fabrics made of the common textiles the authors have determined the water content and strength at various humidities. The results given by the Mullen bursting tester are assumed to indicate the strengths of the fabrics. Linen and cotton fabrics showed an increase in strength with humidity, wool, silk, and rayon the reverse. The linen fabric was found to be 25% stronger when wetted than at 50% atmospheric humidity. —L.I.R.A.

Pectin Content of Flax Fibre. See Section 1c.

7—BUILDING AND POWER

(C)—Power

Steam Accumulation. D. M. Proctor. *Text. Mfr.*, 1926, **52**, 25-27.

A complete account is given of the advantages of a steam accumulator for all power plants where a variable demand has to be met. The accumulator absorbs steam when factory demand slackens and resupplies this automatically when the demand rises to a peak. This enables fewer boilers to be used and facilitates regular stoking, and a large reserve of steam is made available for prompt starting of kiers, &c. A typical layout of an accumulator system is given. —L.I.R.A.

Electrically-driven Flax Mill. *Text. Rec.*, 1926, **43**, No. 514, p. 92.

A description of the electrical plant of the Rydalmere Street Thread Works of the York Street Flax Spinning Co. The group principle is employed, each motor of 15 h.p. driving, through reduction gear shafts 100 ft. long. When the mill is shut down no switches are opened, all machinery being left in connection with the turbo-alternator, and from the starting of the latter the whole mill is running at full speed in 3½ minutes. —L.I.R.A.

(H)—Humidification

Temperature and Humidity; Regulators for——. *Engineering*, 1925, **120**, 704-705.

The instruments described are made by the Steam Fittings Co., West Drayton. The humidity controller is operated by means of the differential expansion of a liquid in a wet and dry bulb system, the actual mechanical movement being obtained from the motion of a piston in a narrow bore cylinder. The temperature controller is designed for steam-heated appliances and will render unnecessary the use of a separate reducing valve. —L.I.R.A.

Humidity Effects on Fabrics. See Section 6.

Patents

Air Conditioning Apparatus. S. Yamamoto, Azabu-ku, Tokyo, Japan. E.P.243,061.

In a process for cooling air and regulating its humidity, the air is dried by passing it through alternately used chambers containing Fuller's earth, Florida earth, to other acid clay absorber, and is cooled and remoistened by contact with sprayed water in a heat-insulated chamber, the heat of absorption imparted to the air in the absorbing chambers being removed by causing the air to pass through a nest of cooled tubes on its way from the drying chamber to the moistening chamber. —B.C.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Cotton Production in China in 1924. *Cotton* (M/cr.), 1925, **31**, No. 1493, p. 9.

The report of the Chinese Maritime Customs estimates the 1924 area under cotton in Shensi, Chihli, Shantung, Honan, Hupeh, and Kiangsu as 10% larger than the preceding years; and the yield was 8,200,000 piculs (1 picul = 133⅓ lb.) or about the same as in the preceding year. Exports amounted to 1,080,019 piculs (an increase of 105,445 piculs on the 1923 figures), of which 890,039 piculs were shipped to Japan. Imports of raw cotton amounted, however, to 110,696 piculs from America and 669,727 piculs from India. —B.C.I.R.A.

Cotton Cultivation in Kenya. *Kenya Dept. Agric. Ann. Rept.*, 1924, p. 22.

The report for the year ended December 1924 gives a crop of 787 tons from the 1923 sowings on over 30,000 acres, i.e., an average of 58 lb. per acre. The crop was damaged by wind, hail, and drought. In South Kavirondo only 250 acres matured a crop, but at Malindi on the coast a fair result was obtained, and a small crop was produced in the Taveta district. The greater part of the crop was, however, produced in Northern and Central Kavirondo. —B.C.I.R.A.

Indian Cotton: Production. B. C. Burt. *Empire Cotton Growing Review*, 1925, **2**, 224.

Short staple East Indian varieties yielded an average of 2,999,000 bales of cotton under ⅞ in. from 1915 to 1918. During the same period the average of ⅞ in. over cotton was 1,161,000 bales. The corresponding figures for the year 1924-1925 are 3,881,000 bales and 2,107,000, yielding increases of 29·4% and 81·5% respectively. The quantities for each commercial variety are tabulated. —B.C.I.R.A.

Cotton Research Station in Nyasaland. H. C. Sampson. *Empire Cotton Growing Corporation. Reports from Expt. Stations*, 1923-1925 (London, 1925), pp. 28-33.

A brief description of the general work done in preparing the new station for experimental cotton growing. —B.C.I.R.A.

Cloth Examiner: Education. H. Binns and C. Burt. *J. Ind. Psychol.*, 1922, **1**, 93-98.

An investigation concerned with the selection, training, and reliability of the trade expert employed in evaluating fabrics. Tests are described in which given samples of woollen materials were arranged in order of value by a number of individuals ranging in capacity from experts in the trade to mentally deficient children showed extraordinary variation in the judgment of the same individual, expert or otherwise, on different occasions, and that broadly the public taste in judging a fabric is more influenced by the superficial qualities of finish, pattern, and colour, than on the constitution and properties of the cloth as measurable by the expert on handling. —B.C.I.R.A.

Textile Operatives: Efficiency. A. Stephenson. *J. Ind. Psychol.*, 1923, **1**, 325-327.

An investigation covering the work of inspectors, of operatives in control of machinery and of operatives performing purely mechanical work such as labelling is described. A comparison of the time for a certain repetitive process to be performed by hand, by hand machine or by treadle machine is interesting as showing that while the actual time of performing

the operation was much the least by treadle machine, the total time of arranging the material and performing the operation was no greater by the hand method than by the machine methods. Certain suggestions for improving machine design and illumination, &c., are recorded. —B.C.I.R.A.

Spinners: Fatigue Investigation. E. Mayo. *J. Ind. Psychol.*, 1925, **2**, 203-209.

A report of an investigation carried out in an American spinning mill in which in spite of good working conditions there was an extraordinarily high labour turnover in the spinning frame department as compared with other departments of the mill. The investigators concerned themselves primarily with the relation of pessimistic reveries to work and to fatigue and found that the chief complaints of the spinners were of the monotony of the work and of foot trouble. A system of rest periods—four a day with modifications—was initiated during which the men lay down and this caused the marked improvement in man-hour production of from 70-75 per cent. to 85 per cent., where 75 per cent. represents the flat wage rate output. During the ten months' trial, labour turnover and absenteeism were reduced to a minimum; on the other hand, output was seriously diminished during a period when, through pressure of work in the factory, the rest periods were abolished; and there was a recurrence of absenteeism indicating that rest periods were being taken in the form of missed days. —B.C.I.R.A.

The Cocoon Market in Hupeh. *Silk Jl.*, 1925, **2**, No. 18, p. 57.

Very few cocoons went on the market until 1893, and even then it was only the farmers' surplus. During the past decade, owing to the influx of buyers from Shanghai, home-reeling has given place to selling. The market takes place during the first week in July, but the necessary organisation occupies a month. Scattered over the province there are now 70 establishments with over 1,000 drying ovens. Each establishment makes a contract with a buyer to dry his cocoons for 0·8% of the purchase price. The buyer has his men on watch during the drying. The ovens are of brick, 12 ft. by 9½ ft. by 4½ ft., and have one or two chambers; poplar wood is used for fuel; there are four firings in 24 hours. A number of figures are given in catties, ounces, piculs and cash.

—F.G.P.

The Japanese Silk Industry. *Silk Jl.*, 1925, **2**, No. 18, p. 60.

Many statistics are given showing that silk weaving and export in Japan had increased between 1913 and 1923, but the peak was reached in 1919, since when the trade has declined. The largest importers of silk handkerchiefs are America and Argentina.

—F.G.P.

A Chair of Cellulose Technology. *Silk Jl.*, 1925, **2**, No. 19, p. 38.

McGill University, Canada, has established this chair. The field of cellulose technology is not confined to the problems involved in the nature and use of cellulose itself. There are many other substances associated with cellulose in nature whose properties are a puzzle, and whose economic application awaits the guiding word from the chemist. Canada leads the world in this foundation, which is described as the most complete faculty in America for this study.

—F.G.P.

Silk Industry of France. *Silk Jl.*, 1925, **2**, No. 19, p. 58.

Thanks to the ample notice given by the Chancellor of English Exchequer of the proposed customs duty on silk the French manufacturers were enabled to export four-fifths of the previous year's total in the first half of 1925 and obtain five-sixths of the previous year's value, and as this quantity was well over half their total exports, the result has been very satisfactory. France produces only one-fifteenth of her requirements, the greater part being imported from China. Spinning and twisting are carried out in the silk-raising provinces, weaving in Lyons and St. Etienne. Some hand looms are still used in the homes of weavers. The annual average price of silk is five times that of rayon. The industry is very thoroughly organised. There is a shortage of 20% in the labour required, and apprenticeship in all branches is encouraged. Loom improvement has not been so great in France as in England and elsewhere.

—F.G.P.

Manufacturers; Costings for——. D. R H. Williams. *Text. Mfr.*, 1925, **51**, 430-431.

A system of costing applied to the weaving of woollen and worsted fabrics is described. It is designed to give a reliable summary monthly or even weekly instead of annually as is often the case at present. Every item of costs is included in one or other of five sections, namely, (1) the cost of the yarn, (2) the cost of production, which includes winding, healding, twisting, tuning, mending, scouring, tentering, and finishing, (3) general expenses or standing charges worked out for one loom as a basis, (4) cost varying as to weight, including sizing materials, water, steam, and carriage worked out as cost per ounce of finished cloth, and (5) cost varying as to value, including interest on value of materials, insurance, patterns, discounts, bad debts, &c., worked out as a percentage of the total costs. The efficiency figure representing the actual loom output as a percentage of that possible with absolutely uninterrupted working is combined with the costs determined as above in order to arrive at the correct selling price per yard of cloth to yield a predetermined profit.

—L.I.R.A.

Linen Industry; Fifty Years in the——. F. Bradbury. *Text. Mfr.*, 1925, Jubilee Number, 1875-1925, pp. 147-155.

The fluctuations in the amount of flax grown and in the number of spindles employed during the last 50 years are described. Recent efforts in the directions of providing improved strains of flax and of facilitating the pulling, retting, and scutching of flax are mentioned as well as advances which have taken place in hackling and carding mechanisms. A brief review of the chief changes which have occurred in weaving practice is also given. —L.I.R.A.

Artificial Silk Plant: Erection. *Text. Merc.*, 1923, **73**, 412.

In connection with the formation of new artificial silk companies it is pointed out that the conversion of old mills is inadvisable. It may end in the need for extensive essential alterations and delay when production should be starting. An efficient lay-out of machinery should be planned and the buildings constructed to suit the lay-out. The selection of the site should receive great attention. Water will be required in enormous quantities and means for the disposal of the effluent. Transport and labour must be available. It is also important to plan a lay-out which will allow for extension and to realise that a small artificial silk plant is not an economic proposition, except in the production of small quantities of speciality yarns. —B.C.I.R.A.

Jute; Spinning and Weaving of, Half a Century's Progress in the——. T. Woodhouse. *Text. Mfr.*, 1925, Jubilee Number, 1875-1925, 156-159.

The author gives statistics showing the growth which has taken place in the jute industry in the last 50 years. Improvements in various sections of the preparing, spinning, sizing, and weaving processes are also dealt with. —L.I.R.A.

10—MISCELLANEOUS

Trichrome Camera. — Bouin. *L'Avenir text.*, 1925, **7**, 468-471.

The apparatus described enables three negatives, produced by light of the primary colours, to be taken simultaneously. It comprises a chamber divided by two opaque screens into three sections. Each screen has an inserted glass section coated with a coloured varnish, through which light can pass. The beam of light from a single objective falls on the first screen which is arranged at an angle of 45° to the incident light and is, for example, red coloured. Part of the light traverses the screen and falls directly on to a sensitive plate, whilst the remainder of the light is reflected to a second plate by way of an interposed green-coloured screen arranged at 45° to the incident beam. Again some light is transmitted and a part reflected, the reflected light falling directly on to a third plate. By superposing films of two of the plates and a print of the third, an image in the natural colours of the object is obtained. Useful application in the textile industries is expected. —B.C.I.R.A.

Photometer. A. Blondel. *Compt. rend.*, 1925, **181**, 310-312 and 449-453.

A portable photometer of universal application, and its manipulation in measuring the photometric efficiency of optical apparatus is described. —B.C.I.R.A.

Stroboscope Lamp. Laurent and A. Seguin. *Comp. rend.*, 1925, **181**, 539-541.

An improved form of high intensity stroboscopic lighting apparatus which permits of the lighting in daylight of inaccessible machine parts and of obtaining illumination over a wide area, for use, for example, in controlling the turning speed of the spindles in a spinning frame. To overcome the shadow trouble in the old Geissler tube type and to increase the intensity of illumination given by the tube the synchroniser and the neon tube are arranged so that the current through the latter is not limited to that passing through the former. —B.C.I.R.A.

Pump: Rotary Air, for Laboratory Work. *Engineering*, 1925, **120**, 816-817.

The pump is driven by a 1/30 h.p. motor fitted in the pump casing and is intended to facilitate blow pipe or filtration work. Pressure reduction amounting to 15 in. of mercury is obtainable or on the delivery side excess pressure up to 5 lb. per square inch may be obtained. —L.I.R.A.

Steel; Non-expansible——. *J. Sci. Instr.*, 1925, **3**, 92-93.

Particulars are given of a nickel steel recently introduced by Thos. Firth and Sons, Sheffield, under the name of "Permant." The mean coefficient of expansion of this steel between 15° and 100° C. is $1 \cdot 1 \times 10^{-6}$. It is supplied in hot-rolled bars of standard sections at 4s. per lb. —L.I.R.A.

The British Silk Association Incorporated. *Silk Jl.*, 1925, **2**, No. 19, p. 68.

The Department of Scientific and Industrial Research has issued a report which is entirely favourable to the conduct and work of the Association. The director and staff are highly praised for their accuracy and unbiassed judgment, and their reports are characterised as being all that scientific papers should be. The financial side is administered with strict regard for economy. Every branch of the industry is being helped. From now on the industry will need to increase its contributions as the subsidy will be gradually decreased until at the end of the tenth year the Association will no longer receive assistance from the department. —F.G.P.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Artificial Wool: A Comparison of Animal and Vegetable Fibres. H. Priestman. *Wool Record*, 1926, **29**, 528.

The author attempts to justify the use of the term "artificial silk," by pointing out its many characteristics which it shares with real silk. Two points in which they do, however, differ are—artificial silk can only be dyed with material which will colour vegetable fibres and real silk with dyes used for wool. Real silk is almost as strong wet as dry, whereas artificial silk loses well over 50% of its strength when wet. So-called "artificial wool" manufactured from seaweed or ramie possesses widely different characteristics from wool, which is a growth, not manufactured. The interior of the wool fibre has a definite structure and possesses a peculiar type of elasticity that no structureless fibre can imitate. Spindle-shaped cells form the interior of the best bred wool and are completely surrounded by a coat of overlapping scales with their projecting edges, which have an enormous influence in the milling process, provided the fibres point in opposite directions. The decided "crimp" of wool causes air to be imprisoned in the wool more than in any other fibre. Cotton, flax, ramie, and manilla make magnificent close, smooth fabrics, which are not ideal for clothing, but any of these could be mixed with wool to form a warm and strong material. Raw materials made by artificial means again can only be made to hold air by the clever addition of wool in the right places. Artificial silk is exceedingly bright whilst wool is dull. One of the best fibres used so far for blending with wool is Sniafil, a product of the Snia-Viscosa Co., Italy.
—B.R.A.W. & W.I.

Action of Sulphides on Keratin: Production of Cystine. —. Bergmann and —. Statter. *J. Soc. Chem. Ind.*, 1925, **44**, B516 (from *Collegium*, 1925, p. 109).

Wool (250 g.) was converted into a thin gelatinous mass by treating with a solution of sodium sulphide, slightly acidifying with HCl and then removing the water and hydrogen sulphide by reduced pressure. The dry product was boiled under a reflux condenser with strong HCl, the solution filtered, clarified with animal charcoal and neutralised with alkali. The precipitate contained 6·42% S, corresponding to 9·7 g. of cystine. Wool not subjected to sodium sulphide treatment gave a precipitate containing 7·56% S corresponding to 13 g. of cystine. Decomposition of the cystine was much greater in the case of horse hair which had undergone the sodium sulphide treatment.
—B.R.A.W. & W.I.

(C)—Vegetable

Cellulose and Starch: X-ray Structure. R. O. Herzog and H. W. Gonell. *Chem. Zentr.*, 1925, ii., 132-134 (from *Naturwissenschaft.*, 1924, **12**, 1153-1155).

Two summaries of recent literature dealing with the X-ray examination of the structure of cellulose and other natural products.
—B.C.I.R.A.

Element-dyed Ramie; Dichroism of——. A. Frey. *Chem. Zentr.*, 1925, ii., 350 (from *Naturwissenschaft*, 1925, **13**, 403-406).

A study of the causes of dichroism of dyed fibres. Ramie fibres dyed with the elements P, As, Sb, Bi, S, I, &c., exhibited dichroism except in the case of P and S; with Cu, Ag, and Au there is characteristic selective absorption. Dichroism in the groups P, As, Sb, Bi, &c., is more sharply defined as the metallic character increases, but it is also quite evident with nonconductors such as iodine. As opposed to the lattice theory of Braun, the fibre in many dyeings is brighter if the electric vector is perpendicular to the direction of the fibre. All the observations may, however, be traced to the optical properties of the deposited particles which apparently are oriented by adsorption. Since liquid substances (mercury and bromine) give dichroic coloration and the dichroism is retained during chemical reactions the author assumes that the oriented adsorbed particles are not submicroscopic crystals but their ions, atoms, or molecules. —B.C.I.R.A.

Sea Island Cotton: Growth and Spinning Data for St. Vincent. L. H. Burd. Empire Cotton Growing Corporation, *Reports from Expt. Stations*, 1923-1925 (London 1925), pp. 34-48.

Complete data for nine pure strains are provided as follows—Daily rainfall, temperature and other meteorological records; flowering, bolling, and boll shedding records; staple (sledge sorter), lint index and ginning out-turn; scutcher, comber, and card losses; lea pulls at 240's counts; hair weight per cm., hair strength, and strength per unit weight. —B.C.I.R.A.

Light and Growth.—I. The Effect of Brief Light Exposure upon Etiolated Plants. J. H. Priestley. *New Phytologist*, 1925, **24**, 271-283.

Experiments are described which show that in certain species etiolated plants are very

sensitive to daily exposures to light of only a few minutes' duration, marked morphological changes in the shoot appearing as a result. —L.I.R.A.

Modern Ideas about Cotton. A. J. Hall. *Dyer and Calico Printer*, 1926, **55**, 104-105.

A description of the structure and methods for examining cotton hairs. The greater porosity of coarse cotton hairs is associated with their greater affinity for dyestuffs as compared with fine cottons. Methods for obtaining cross sections of cotton hairs are described. A classification of the world's cottons together with statistics relating to production and consumption is given. —A.J.H.

Cotton Hair: Reversing Spiral Measurements. W. L. Balls and H. A. Hancock. *Proc. Roy. Soc.*, 1926, **99B**, 130-147.

Selections from a mass of statistical data describing the dimensions and form of the spiral arrangements which occur in the cell wall of cotton hairs are presented. The spirals may be dexter or sinister, and their reversals are apparently predetermined during growth in length. Genetic and ordinary environmental influences do not affect the statistical peculiarities of the reversals. The final adult length of the hair, and the time taken in reaching that length, do affect the reversal distribution. Nearly all the seed hairs of *Gossypium* begin to grow on a sinistral spiral, i.e., the opposite hand to an ordinary screw thread. The basal sinistral spiral increases in length, is broken up, and later additions may be made to its fragments. Similar extension, fragmentation, and subsequent addition takes place with the later dextral spiral. The angle of the helix varies somewhat around two nodal values, namely, approximately 27° dexter and 27° sinister. The local variations of the angular value are quite unaffected by inversion of the "hand" of the angle from dexter to sinister. Dexter and sinister wall structures have been found in some hairs to have different structural properties in their resistance to collapse after the death of the cell. A tentative explanation of the cause of reversal is offered, but attention is drawn to its insufficiency and to the need for experimental evidence. —B.C.I.R.A.

Cotton Production in French Indo-China. J. Cardot. *Bull. Imp. Inst.*, 1925, **23**, 346-349 (from *L'Agron. Colon.*, 1924, **11**, 161; 1925, **12**, 15, 44.

Details are given of the species grown, the provinces under cotton (with areas stated), the picking seasons, ginning methods, pests, and yields. Local manufactures consume much more than the local supply. —B.C.I.R.A.

Cotton Production in Argentina. *J. Roy. Soc. Arts*, 1926, **74**, 199-200.

Cotton was grown for domestic consumption 300 years ago. At the present time the "Gran Chaco" is the great centre of cotton production. It has an area of 52,741 sq. miles, but the population averages only one to the square mile. Parts of Formosa, which has an area of 41,402 sq. miles, are claimed to be even better adapted for cotton growing, but the country is as yet little developed and transport communications are absent. Allowing for the available areas in other provinces a total area of 165,000 sq. miles offers prospects for future cotton growing. Costs of production are relatively low, and the only serious trouble is the attack of locusts. By erecting corrugated iron barriers to the progress of the insect during the hopping stage and burying the insects in trenches, the National Department claims to have destroyed during the last season over 300 million pound weight of locusts. An average yield of 227 lb. per acre is usually reckoned on. The total area for the 1924-1925 crop was about 100,000 acres and the yield about 47,000 bales of ginned cotton. —B.C.I.R.A.

Cotton "Damping-off" Disease: Cause. H. R. Rosen. *Rev. Appld. Mycology*, 1926, **5**, 30 (from *Phytopath.*, 1925, **15**, 486-488).

It has generally been assumed that damping-off of cotton is chiefly due to *Rhizoctonia*, but observations are described from which it appears that *Fusarium vasinfectum* plays an important part in its causation. There is little difference in the symptoms produced by these two organisms, but the discoloration due to *F. vasinfectum* is almost black and occasionally extends upwards through the xylem beyond the rotted collar, whilst that caused by *Rhizoctonia* is reddish, wine-coloured, or purplish and usually localised at the collar. At about 28° C. *Rhizoctonia* makes much more vigorous growth than *F. vasinfectum*. *F. vasinfectum* attacks through the roots and may be expected to cause most severe damage at rather high soil and air temperatures, whereas the *Rhizoctonia* symptoms are likely to be more pronounced in cool, damp weather. —B.C.I.R.A.

Angular Leaf Spot Disease: Control. *Tropical Agric.*, 1926, **3**, 8-9.

A short article on the symptoms and control of angular leaf spot. Trials made at the St. Vincent Experiment Station in 1923 confirmed the results of Ludwig (E. 1923, 9) on the efficacy of seed disinfection with sulphuric acid or mercuric chloride and showed that immersion in Izal, 1 part to 250 parts of water, is also effective. —B.C.I.R.A.

Stained Cotton: Causes. E. Ballard *Rev. Appld. Entomology*, 1925, **13**, 520 (from *Queensland Agric. J.*, 1925, **23**, 542-545).

Staining is a result of internal boll rots, due to fungi, chiefly *Fusarium monoiliforme* and bacteria, which enter when the

boll is punctured or similarly damaged. Such damage may be due to the attacks of *Heliothis obsoleta*, *Dichocrocis punctiferalis*, *Earias huegeli*, *Platyedra gossypiella*, *Crocidosema* (*Eucosina*) *plebeiana*, *Tectocoris banksi* or *Dysdercus sidæ*. The destructive powers of the last two are often underestimated. *T. banksi* feeds equally readily on the seeds of open bolls, on the green bolls or on the leaves, whereas *D. sidæ* is generally found in open bolls, preferring to feed on cotton seed, but once it is attracted to the field it may be found on both ripe and unripe bolls. In experiments in which examples of these species were confined individually in healthy bolls staining resulted in a large number of cases to an extent which would have penalised the cotton at least 50 points on the Liverpool market. As regards the damage done by *T. banksi*, in one 30 acre field 50% of the green bolls were infected with boll rot, 27% more with boll rot and *D. punctiferalis* and 6% with *P. gossypiella*, in some cases together with boll rot. No suitable control method for *D. sidæ* under Queensland conditions has been evolved. Hand collection of all stages of *T. banksi*, including the egg-masses, should be done thoroughly and started early.
—B.C.I.R.A.

Jassid-Resistant Cotton Cultivation in South Africa. L. Worral. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 393 (from *J. Dept. Agric. Union S. Africa*, 1925, **10**, 487-491).

Though all the American Upland cotton grown in South Africa has a certain resistance against the attacks of *Empoasca* (*Chlorita*) *facialis*, no variety has been found to be absolutely immune. A variety received from India is described and though it is too early to predict the behaviour of this cotton under all the varying conditions found in the cotton belt of South Africa, it is hoped that it may prove of value, as it at least has the necessary resistant qualities. —B.C.I.R.A.

Cotton Bollworm Life-history: French West Africa. P. Vayssière and J. Mimeur. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 170 (from *Agron. colon.*, 1925, 6-14).

The spiny cotton bollworm *Earias insulana*, occurs practically wherever cotton is grown, except in North and South America. It is one of the major pests of cotton in Africa. It appears to have decreased in numbers in Egypt since the invasion of Egypt by the pink bollworm, but in French West Africa it is still one of the most serious pests. The various stages of its life history are described. The eggs are laid on all parts of the plant but chiefly round the flower buds and capsules and at the points of the leaves and bracts. The emerging larvæ penetrate the young branches or buds. The cocoon is found in various positions on the plant. The durations of the egg, larvæ, and pupal stages vary according to the season from 3-12, 15-28, and 10-52 days respectively. In April in the Sudan a cycle is completed in 32 days. The generations are continuous throughout the year in Egypt. In Senegal and the Sudan *E. insulana* occurs from February to July on biannual cotton plants and some species of Hibiscus and Malvaceæ, particularly those growing in humid places. Natural enemies are recorded from Egypt and India. *E. biplaga* is very similar in life-history to *E. insulana*. It occurs in all African cotton-growing districts and apparently only on cotton. —B.C.I.R.A.

Cotton Bollworm Control in South Africa. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 2 (from *J. Dept. Agric. Union S. Africa*, 1924, **9**, 311-312).

The bollworms which occur in South Africa are the Sudan bollworm, *Diparopsis castanea*, which has been found in the bolls of a wild species of cotton, the spiny bollworm, *Earias insulana*, found in several species of *Hibiscus*, and the American bollworm, *Heliothis* (*Chloridea*) *obsoleta*. All three oviposit on the cotton plant and the larvæ feed mostly on the squares (buds) and bolls. Pupation occurs in the soil or on the stem of the cotton plant, so that the larvæ cannot be disseminated in cotton seed. Experiments in spraying and dusting have been discouraging. Calcium arsenate is to be further tested and in the meantime the recommendations for keeping down the pests are the choice of soil of a sandy-loam texture, ploughing and harrowing twice early in the winter (before mid-August), after which the land is left fallow through the winter, the use of good seed planted early, cultivation of the crop, and destruction of any cotton or other food-plant growing outside the cotton field. Ratooning is not recommended as it allows the bollworms to increase unchecked. —B.C.I.R.A.

Boll Weevil: Control. E. F. Grossman. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 258 (from *J. Econ. Ent.*, 1925, **18**, 236).

The cotton boll weevil, *Anthonomus grandis*, takes up poison accidentally on the tip of the proboscis and later, when chewing or moving its mandibles, the poison is introduced into the intestine. Sprays are less efficient than dusts because as the spray dries it forms a varnish-like film of poison which does not adhere to the proboscis of the weevil crawling over the poisoned area, whereas loose particles of dust do so readily. —B.C.I.R.A.

Cotton Pests Occurrence in Belgian Congo. J. Ghesquière. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 453 (from *Bull. Agric. Congo belge*, 1925, **16**, 263-270).

A recent survey has again shown that the reports of the existence of *Platyedra gossypiella* in certain districts of the

Belgian Congo are erroneous. *Heliothis obsoleta* occurs but is not an important pest. *Earias insulana* is more serious and occurs later in the season. Of the cotton-stainers, *Dysdercus nigrofasciatus* and *D. fasciatus* are the most widely distributed in the district under review. *Sciocoris fuscosparus* caused certain damage to young capsules in one locality, its occurrence possibly being due to the proximity of the forest. A list of the various trees serving as food plants for *Dysdercus* is given, and their destruction is recommended. *Heterodera radicicola* occurs on cotton and many cultivated plants; its abundance is considered to be a result of the sandy nature of the soil. —B.C.I.R.A.

Cotton Pests Control in Russia. A. M. Panteleev. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 308 (from *Cotton Industry* (Moscow), 1925, **4**, 72-74).

The more important cotton pests of Egypt and America do not occur in the Russian cotton fields and with the object of preventing their introduction the United States of America were asked to guarantee that all cotton exported by them to Russia was uninfested. This was refused and the importance of organising adequate quarantine measures against the importation of foreign cotton pests into Russia is pointed out. —B.C.I.R.A.

Cotton Pests in Australia (New South Wales). W. B. Gurney. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 230 (from *Agric. Gaz. N.S.W.*, 1923, **34**, 887-893, and **35**, 49-55, 137-138, 422-428).

About 30 species of insects have been found attacking cotton in New South Wales. Four papers summarising the present state of information concerning the chief of them are quoted. The papers suggest suitable control measures, general suggestions, and especially preventive measures, including winter ploughing, frequent and persistent cultivation, stubble and weed destruction and early planting. Specific species and their principal characteristics are mentioned in the abstract. —B.C.I.R.A.

Cotton Pests Control in Tanganyika. A. H. Ritchie. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 76 (from *Rept. Dept. Agric. Tanganyika Territory*: 15 months ending March 31st, 1924, 22 pp.).

Compulsory measures for the control of cotton pests and diseases included uprooting and burning of plants after harvest and export or destruction of all seed remaining on completion of sowing. A study has been made of the internal boll disease of cotton. It is probable that, besides the presence of cotton-stainers and of the causative fungus, conditions must be favourable for the development of the disease, and it seems likely that dull weather, causing slow opening of the bolls and damp inside them, favours it. —B.C.I.R.A.

Cotton Pest in Algeria. J. M. R. Surcouf. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 74 (from *Rev. Bot. Appl. and Agric. Colon.*, 1924, **4**, 752-753).

The moth, *Prodenia litura*, is a menace to cotton growing in Algeria as it breeds on adjacent berseem which offers, in any state of irrigation, favourable conditions for development, and is grown in large tracts. —B.C.I.R.A.

Cotton Pests in St. Vincent. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 22 (from *Rept. Agric. Dept. St. Vincent*, 1923, 23-29).

Two types of cotton, Sea Island and Marie Galante, are at present grown in the St. Vincent Grenadine islands and it is suggested that, to facilitate the control of the pink bollworm, it would be economically sound to grow only one variety, namely, the hardier Marie Galante type. Experiments showed that cottonseed meal can be effectively fumigated with carbon bisulphide at a depth of 12 inches. In the case of cotton seed the effective range of the fumigant might be greater as the material is not so closely packed. There are no indications that *P. gossypiella* can breed or maintain itself in cotton seed meal. The cotton worm *Alabama argillacea* severely infested cotton in the southern part of St. Vincent towards the end of the year in spite of the many parasitic enemies usually present in the island. The organisation of the campaign against the stainer *Dysdercus delauneyi* is described. The leaf blister mite *Eriophyes gossypii* damaged Sea Island cotton sufficiently to render a close season necessary in the Grenadines and mention is made of other minor pests. —B.C.I.R.A.

Fungicides and Insecticides: Testing. E. Riehm. *Rev. Appld. Mycology*, 1925, **4**, 750 (from *Mitt. Biol. Reichsanst. für Land-und Forstwirtsch.*, 1925, **26**, 88 pp.).

A bibliography of 426 titles is appended to a report on the testing of plant disinfectants in the year 1923. —B.C.I.R.A.

Cotton Seed Beetle: Peru. J. Brèthes. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 232 (from *Rev. Chil. Hist. Nat.*, 1924, **28**, 67-72).

The Anobiid beetle, *Cathorama gossypii*, occurs in Peru where it attacks cotton seed. —B.C.I.R.A.

Cotton Leaf Miner in Bahia. G. Bondar. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 231 (from *Correio-Agric.*, 1925, **3**, 44-46).

The leaves of cotton in Bahia are often mined by the small caterpillars of *Acrocerops helicometra*. The mature larva spins a white silk cocoon, the pupal stage lasting 6-7 days. The total development requires about a month. The larvæ are common from April to September on cotton. —B.C.I.R.A.

Cotton Jassids: French Sudan. J. Vuillet. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 74 (from *Rev. Bot. appl. and Agric. colon.*, 1924, **4**, 757-759).

Jassids are among the most dangerous of the less-known pests of cotton, the chief being *Empoasca devastans* and *E. notata* in British India, and *Chlorita facialis* in South, East, and West Africa. In plantations infested by Jassids, the leaves become deformed and fall, growth ceases and the plant may die. Leafroll has already been shown to be caused by *C. facialis* in East Africa; infected leaves become cup-shaped and there is a close relation between the spread of bacterial rust of cotton and of mosaic disease and the increase of this insect. Colonies of *C. facialis* live on the lower surface of leaves about the base of the principal veins. In the Niger Valley this leafhopper attacks native cotton less than American or Egyptian varieties. In the French Sudan the development of the insect takes from 20-24 days in October and is more rapid in the dry season. Incubation seems to require only nine days and the adult stage is reached in another nine or ten. Damage appears to be much less severe on ground containing mineral fertilisers, especially potash. Spray experiments have been made, but so far are inconclusive. —B.C.I.R.A.

Cotton Stainer Control in St. Vincent. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 135 (from *Rept. Agric. Dept. St. Vincent*, 1922, 20-26 pp.).

Work in connection with the control of *Dysdercus delauneyi* includes destruction of its food-plants and of the insect itself, the latter both during the close season for cotton and afterwards. Infestations were discovered in a sugar-cane field and an arrowroot field, both of which had been manured with cotton seeds. Experiments to ascertain the effect on cotton-stainers of feeding them on different plants have been continued. The effect of different kinds and qualities of cotton seed meal is also discussed. No attempt is made by the insects to reach cotton seed meal when it is covered with soil, though only to a depth of half an inch, and cotton seed may be buried 6 inches beneath the soil without any fear of plants appearing above the surface. In trap experiments it was found that the insects attracted to cotton seed meal placed in holes in the ground and then covered with soil were all killed and they died more quickly in wet soil than in dry. In all cases they died within 96 hours of being covered. —B.C.I.R.A.

Cotton Stainer Effects in Southern Nigeria. A. W. J. Pomeroy. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 16 (from *Bull. Ent. Res.*, 1924, **15**, 173-176).

Experiments in which adults of *Dysdercus superstitiosus* were placed on young bolls, the buds having been screened before they showed signs of opening, show that the stainer can cause shedding of the bolls by the mechanical action of puncturing them, or that boll disease may be introduced while the cotton is in the flowering stage. Unless the carpel wall is pierced, however, no injury to the boll results either from the insect, or, in all probability, from the disease. Internal proliferation does not take place unless the carpel wall is pierced and is not an essential factor in the shedding of young bolls, but rather indicates injury from an external source. Puncturing by stainers of the buds and flowers, before the flower petals have fallen off may cause the shedding of the boll and the introduction of the disease. Bolls kept free from insect attack do not develop the symptoms of internal boll disease or the condition typical of stainer or bollworm injury. Combined injury by Dysdercus and the larvæ of Lepidoptera produces, in most cases, typical injury by both and also boll disease, but in an instance where the stainer died without puncturing the boll, and the larva died without piercing the carpel wall, the boll developed normally. Aphids occur occasionally in Southern Nigeria but they do not pierce the carpel wall, whilst bollworms invariably bore through the boll and destroy the interior. —B.C.I.R.A.

(D)—ARTIFICIAL

Viscose Silk Manufacture. J. W. W. Shuttleworth. *Text. Mfr.* Jubilee Number, 1925, 173-182.

A general account of the manufacture and spinning of viscose, with detailed descriptions of Messrs. Dobson & Barlow's plant. —B.C.I.R.A.

Artificial Silk Solution Filters. Buhring Filters, Ltd. *Silk J.*, 1926, **2**, No. 20, 57.

Two improved filters for use in the manufacture of artificial silk, and respectively for acid and alkali solutions, are illustrated. They are characterised by large filtering surface and are self-cleansing. —B.C.I.R.A.

Staple Fibre: Properties and Production. *Silk J.*, 1926, **2**, No. 20, 55.

Staple fibre can be mixed with cotton, wool, and other fibres, the mixtures possessing unique qualities. The lustre of a staple fibre-cotton mixture is not the metallic lustre of artificial silk but more nearly approaches that of natural silk. The lustre is much finer than that of the finest mercerised yarn and it can be produced with cheap cotton which in the ordinary way would produce no lustre. A company has been formed to reproduce the Breslau factory of Messrs. Sindl and the Maurer Co. in Lancashire. The first unit will be capable of producing one ton of artificial silk and one ton of staple fibre per day, and the design of the factory will

permit of production being increased rapidly by adding successive units. The directors of the "Nuera" Art-Silk Co. Ltd. estimate that the new buildings will be erected and the specialised plant and machinery installed and working within 12 months. —B.C.I.R.A.

Viscose Thread: Physical Properties. A. L. Wykes. *Silk J.*, 1925, **2**, No. 17, 40-41; No. 18, 45-46; No. 19, 43-44; and 1926, **2**, No. 20, 47-48.

Tests made on a hank of 250 denier undyed viscose thread are described. Extension and elasticity measurements were made in a single thread tester on lengths of 12 in. The effect of winding under tension was investigated by determining the "wear left in the thread" as shown by the area of the load-extension curve. By preventing the tension at any time during manufacture from exceeding one-half of the breaking load of the thread, very little wear is taken out. If this tension is exceeded the wear in the thread is very considerably reduced. The breaking load of the thread is very slightly increased during winding and is also greater the shorter the time taken in breaking the thread. Artificial silk threads should never be handled in a damp state. The general principles for good winding are discussed in relation to the results obtained and the causes of some common defects such as bright picks, tight picks and tight warp ends are indicated. Friction causes a proportional loss in strength of artificial silk threads. The effect of tension on the elastic limit and the effect of wetting thread strained by excessive tension is shown. —B.C.I.R.A.

"Celta" Artificial Silk: Properties. Sir T. Taylor. *Silk J.*, 1925, **2**, No. 19, 60.

Further information in which it is stated that all "Celta" filaments are really hollow, but that owing to the process of degassing or deflating, they may have a solid appearance. The process of making hollow filaments may be applied to all types of artificial silk bases. —B.C.I.R.A.

Artificial Silk Manufacture. *Silk J.*, 1925, **2**, No. 18, 54.

The Linium Products Syndicate, Ltd., which already has a factory in Yorkshire and an experimental plant at Lenton in Nottinghamshire, proposes to erect a factory in the Nottingham district. The company produces a fine quality silk by a development of the Foltzer process which is described as a cross between the cuprammonium and viscose processes. The cellulose raw material is obtained from plants grown in East Anglia, the company distributing the seed to the farmers and harvesting the crop. The product is stated to be particularly fine, strong, and of abnormally high elasticity. Moreover, there is very little waste in production. —B.C.I.R.A.

Artificial Silk: Stretching Properties. *Dyer and Calico Printer*, 1926, **55**, 120.

Uneven humidity conditions during the winding and weaving of viscose and cellulose acetate silk yarns produces yarn having uneven denier and varying dyeing properties, since the moisture content of artificial silk has a considerable influence on its extensibility under tensile strain. For example, viscose yarn at 45% humidity stretches 13½% and then breaks under a load of 44 lb., whereas similar yarn at 85% humidity stretches 19% and breaks under a load of only 35 lb. Cellulose acetate yarn is affected similarly but to a less extent. —A.J.H.

Cellulose and Regenerated Cellulose: Zymolysis. P. Karrer, P. Schubert, and W. Wehrli. *Helv. Chim. Acta.*, 1925, **8**, 797-810.

Continuing previous work, the authors show that the method of precipitation of the cellulose has a considerable effect on the rate of enzymic hydrolysis, for example, viscose cellulose undergoes 57·5% decomposition in the same time as cuprammonium cellulose undergoes only 7·8%. The differences in resistance to cellulose are ascribed to different micellar structures. If the dilution of the enzyme solution is increased in a geometrical ratio, decomposition decreases in an arithmetical ratio, and therefore, for practical purposes the concentration of the enzyme must be maintained as high as possible. The hydrolysis is at first approximately unimolecular and subsequently, up to 50% decomposition, follows Schütz's rule. Between 10 and 50% decomposition, doubling the amount of enzyme increases to about 1½ times the quantity of cellulose decomposed. Commercial viscose silks from different sources showed varying resistances to the action of cellulose. The "milky" places sometimes found in viscose silk fabrics are much more easily hydrolysed than the undamaged viscose. The zymolysis of natural cellulose by snail lichenase is very slow. The efficiency of the enzyme falls from 17·2% at 30° to 3·2% at 60°. —B.C.I.R.A.

Application of the Synthetic Esters of Fatty Acids to Textile Fibres. S. Spiess and J. L. Bitter. *Text. Rec.*, 1926, **43**, No. 516, 68-69.

Synthetic oils obtained by the esterification of cheap waste products such as the fatty acids of palm oil, cocoanut oil, and earthnut oil are suitable for application to wool in the processes of combing and carding. The methyl and ethyl esters yield satisfactory results, and they may be obtained having desired properties by suitable modifications in their method of manufacture. In large scale trials, only minor difficulties were experienced. For combing dried and scoured long-wool fibres a suitable lubricant is a neutral ester

containing 15% of free fatty acid. Esterified waste olive oil appears to be suitable and cheap for use in combing and carding. —A.J.H.

Patents

Inflated Artificial Silk Threads: Manufacture. British Enka Artificial Silk Co. Ltd., London. E.P.244,446.

More or less hollow artificial fibres of a flat ribbon shape are made by spinning solutions such as viscose or cuprammonium solutions containing substances which produce or evolve gas, under such conditions that in the preliminary coagulation no evolution of gas takes place although the filaments are still elastic and sufficiently strong to be wound, thereafter the evolution of gas which inflates the fibre is produced in a subsequent fixing bath. Alternatively, the gas producing substance may be incorporated in the filaments after spinning by treatment of the weak elastic filaments with a solution of the substance, for example, a solution of carbonate or bicarbonate. Means of securing the initial incomplete coagulation of the spinning bath are indicated. The substances producing gas in a normal viscose solution are carbonates, thiocarbonates, carbon disulphide, &c. In examples, a viscose containing 5% of sodium carbonate is spun in an ordinary acid bath, then treated in an ammonium chloride bath maintained alkaline by the addition of sodium carbonate and immediately or after winding, treated with an acid bath of low concentration. Cuprammonium solution is spun in the usual manner, and immediately after spinning the filaments are introduced into a solution of sodium bicarbonate and afterwards treated with dilute acids. —B.C.I.R.A.

Cuprammonium Silk Filaments: Coagulation. J. P. Bemberg Akt.-Ges., Barmen, Germany. E.P.244,492.

In the manufacture of artificial silk from cuprammonium solutions, coagulation of the filaments is effected by water at a low temperature to such an extent that solidification of the filaments is incomplete, thereafter the filaments are led out of the spinning apparatus and treated, as for instance, in a channel or bath, with water at a higher temperature in order to complete the solidification process. By this method of operation, the formation of deposits on the walls of the spinning apparatus likely to cause rupture of the filaments is avoided. In an example, the first bath has a temperature of 20° C. and the second bath of 50° C. Alkalis or salts may be added to the second bath. The process is stated to be applicable to the spinning of solutions of cellulose esters or ethers, such as cellulose acetate or ethyl cellulose. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Production of Artificial Fibres—

244,324. B. Borzykowski. Addition to E.P.239,482. Refers to removal of washing fluid.

244,788; 244,789. F. K. Fish. Process for obtaining cellulose from plant material.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes.

Ret-promoting *Bac. felsineus*, **Carbone, and** *Plectridium pectinovorum* (**Bac. amylobacter, A.M. and Bredemann**). G. Ruschmann and W. Bavendamm. *J. Soc. Chem. Ind.*, 1925, **44**, B876 (from *Zentr. Bakt u. Parasitenk.*, 1925, **64**, 340-394).

The ret-promoting *B. felsineus* described by Carbone does not appear to be common in Germany, but its recognition is difficult owing to the presence of *B. Amylobacter*. For the recognition of small quantities of the latter the use of potato broth tubes and symbiosis with *Saccharomyces* is recommended, and the amounts present in seeds, raw flax, dew-retted and water-retted flax, fibres, and soil have been determined. To test its retting power a suitable medium and good well-sterilised flax stems are necessary. The active bacteria always exhibit the plectridium form. A type which liquefies malt-gelatine and has the plectridium form is designated *Amylobacter liquefaciens*, and an inactive type in the *clostridium* form as *Amylobacter non-liquefaciens*. Pectin consumption and ret-promotion are not necessarily equivalent. In some circumstances passage through the soil may change the anaerobic *Amylobacter liquefaciens* into an aerobic form. Dextrose-gelatin is not liquefied by *Amylobacter liquefaciens*, probably owing to the inhibiting action of the dextrose, but it is liquefied by *B. felsineus*. *Amylobacter non-liquefaciens* does not develop liquefying power by passage through the soil and, unlike *Amylobacter liquefaciens*, it does not secrete *pectinase*. *B. felsineus* is preferable to *Amylobacter liquefaciens* because it attacks the cortical tissue more energetically and frees the fibre better without damaging it; both contain proteolytic enzymes. Passage through the soil does not cause enzyme formation by *Amylobacter non-liquefaciens*, but promotes that of the *Amylobacter liquefaciens*, *B. felsineus* and *Amylobacter liquefaciens* do not secrete cellulose; the former can fix nitrogen but does not produce butyric acid and in spite of its superiority for retting it is destroyed by the latter in pure culture. For the isolation of the strongly anaerobic *B. felsineus*, a simple but highly efficient

apparatus was designed. Contrary to the statements of Carbone this bacillus is mobile, gram positive, and contains glycogen. An especially suitable culture for ret-promoting *Amylobacter* bacteria is prepared from flax stems from which the air has been pumped out. —L.I.R.A.

(B)—Spinning and Doubling

Doubling Spindles: Driving. H. Eigenbertz. *Text. Rec.*, 1925, **43**, No. 510, 45-46; 1926, **43**, No. 514, 47.

Some general remarks on methods of driving the spindles of flyer and ring doubling frames. —B.C.I.R.A.

(C)—Subsequent Processes.

Artificial Silk Reeling Machine. J. Stubbs, Ltd. *Text. Mfr.*, 1926, **52**, 19.

In the machine described for reeling the yarn into hanks whilst wet the swifts are made to take only one or two hanks, an arrangement for which increased production is claimed. A further provision to secure maximum production is the fitting of doffing benches in rows between the reels and the supply of spare swifts in the proportion of two to every three in active use, so that the reels can be kept in constant operation. The machine is made of acid-resisting metal or painted with acid-resisting paint and its parts are interchangeable. Each swift is driven by a small chain through a specially designed patent friction clutch which provides for a slow start and a gentle acceleration to top speed. A patented releasing arrangement on the swift closes the legs diagonally, permitting the hank to drop off easily. An important feature of the machine is the crossing motion which makes perfectly clear, diamond-shaped openings which greatly facilitate easy lacing and tying. —B.C.I.R.A.

(D)—Yarns and Cords.

Artificial Silk and its Admixture with Wool. A. B. Shearer. *Text. Merc.*, 1925, **73**, 513.

A lecture comparing the characteristics of wool and viscose, showing how properties lacking in one fibre are supplied by the other. The different forms in which viscose is obtained to-day and the methods of combination with wool are described. Artificial silk in the form of "singles" may be used as 1/weft with worsted warps, 2/warp with worsted weft, 3 and 4/ doubled with worsted or cotton yarns used as either warp or weft. "Straw" may be used as 1/warp for production of trimmings or similar special fabrics 2/weft as an effect. 3/Warp as an effect 4/checked warp and weft for effect purposes. "Fibro" is usually prepared into top form and then mixed with wool in either grey or dyed form, or it may be spun unmixed. Waste is broken up and spun to produce similar yarns to those made from "Fibro." Humidity and conditioning were important factors to the manufacturer. Where a manufacturer wished to wind his own weft it should be done in two stages—hank to small flanged bobbin and bobbin to pirn. Winders' knots should be put to the outside of the pirn and the shuttles be lined with fur. —B.R.A.W. & W.I.

Yarn: Twist and Elasticity. *Rev. Textile*, 1924, **22**, 125-133.

The writer discusses torsional rigidity as applied to twist in cotton yarns and outlines two theories put forward by Gégauff and Müller respectively, on which they base formulæ for arriving at the strength of a given yarn. Müller concludes that twisting does not set up fatigue in the hairs and that elasticity increases with twist; while Gégauff considers that, above a certain limit, twist induces fatigue in the hair and may cause rupture of the yarn, and that elasticity decreases with twist, since it is minimal in fine yarns possessing a high degree of twist. —B.C.I.R.A.

Patents

Degumming of Raw Vegetable Fibres. A. Silbermann. F.P.587,935.

The process consists of treating these raw fibres by oxydising agents and salts of light acids at a temperature of at least 100° C. and preferably under pressure. The salts used for this treatment are advantageously those of acids acting in colloidal solution, e.g., fatty acids, silicilic acid, hydrate of tin, hydrate of alumina, &c. Oxydising and saponification can be thus realised in one operation or separately. —Bur. Text.

Winding Machine Cop Driving Rollers. J. O. McKean, Westfield, Mass., U.S.A. E.P.243,319.

In order that ready access may be obtained to the traverse mechanism of winding machines without dismantling the machine, the cop holders and auxiliary frames that carry the cop-driving rollers are so mounted that each can be moved by hand out of the way. The cop-driving roller shaft is driven at a constant speed and the cam shaft is driven at a variable speed. —B.C.I.R.A.

Paper Spinning Tube Winding Machine. J. Lumpp, Tubingen, Wurttemberg, Germany. E.P.243,463.

In a machine for winding paper tubes for spinning, of the type in which the paper is fed in a direction which forms an acute angle with the axis of the winding mandrels, the upper edge of each spring-controlled gripper tongs in opening moves over an arc relatively to the mandrel. The tongs are actuated by cams on a shaft and are held open by a spring-controlled catch engaging an extension, a second cam being provided to trip the catch and close the

tongs. The tongs are moved laterally on carriages by rods actuated by eccentric discs mounted on the driving shaft and provided with straps. The gripping edges are always parallel to the mandrels. Adhesive is applied whilst the tubes are being wound on the mandrels, and the adhesive applying mechanism and the mechanism by which the wound tubes are doffed is detailed. —B.C.I.R.A.

Carding Engine Reversible Rope Drive. T. Thornley, Tonge Moor Road, Bolton. E.P.243,481.

In a reversible rope drive for the cylinder of a carding engine an endless rope is passed over a pulley on the cylinder shaft, over an adjustable carrier pulley above the line shaft, and in a reverse direction over a second pulley on the cylinder shaft. There are three pulleys on the cylinder shaft, two loose, and a central fast pulley. Either loop can be moved on to the central fast pulley, and the grooves in these pulleys are shallow to allow of easy transference of the rope. The rope passes more than half-way round both top and bottom pulleys. The ordinary belt pulley on the line shaft may be utilised. —B.C.I.R.A.

Spinning Frame Roller Coupling. E. J. Welffens, Longsight, Manchester. E.P. 243,579.

The front roller shaft of spinning machines is driven from an end shaft through a coupling, so as to facilitate the removal of the rollers for cleaning. —B.C.I.R.A.

Spinning Rings. S. S. Gordon, Providence, R.I., U.S.A. E.P.243,594.

The patent relates to rings for spinning and twisting machines, of the kind formed of two concentric members having coplanar flanges, the edges of which are spaced apart to form a slot through which projects a shank which, with an attached shoe, constitutes the traveller. The ring is provided with tracks for the traveller and with oil channels forming a reservoir connected with the guiding surfaces of the tracks by capillary ducts inclined in the direction of travel of the traveller, so that the movement of the traveller exercises a slight suction effect and causes a diffusion of oil to the guiding surfaces. Strands of yarn are laid in the channels and may be extended into the ducts and the channels are supplied through an opening. The traveller comprises a bronze shank secured to a shoe, and is formed from a blank, the edges being bent to form a cylindrical shank. A brake ring is provided to retard the traveller at high speeds. —B.C.I.R.A.

Artificial Silk Spinning Box Covers. Metallhütte Baer & Co., Kommanditges, and E. Baer, Baden, Germany. E.P.243,952.

Covers for spinning boxes for artificial silk are arranged to be fixed without the use of grooves in the interior which is smooth. In one modification, a spring clamp engages over the cover and has resilient lugs which engage the beaded or grooved edge of the box. Positioning lugs on the clamp engage in the central hole of the cover. Instead of the separate spring clamp, the cover may have an integral slotted resilient rim to engage over the edge of the box. The rim may be incomplete. In another modification, the fixing means comprises studs fixed in the top or periphery of the box rim and slots in the cover. In a further modification, a soft rubber ring arranged in a grooved part of the cover which enters the box, is pressed by centrifugal action against the box which is formed with a series of holes. The cover may be a solid grooved member or formed of a dished aluminium portion and a hard rubber disc riveted together. —B.C.I.R.A.

Combing Machine Nipper Frame. J. W. Nasmith, Heaton Mersey, Manchester. E.P.244,250.

In an arrangement of the kind described in the parent specification No. 132,987, for mounting and operating the nipper, the pivot on which the nipper frame is hung has imparted to it a slight oscillating movement at each stroke. The lever carrying the pivot has an arcuate bearing slot embracing a headed stud. It is also connected through an adjustable rod to a lever on a shaft. An adjustable stud secured in a graduated slot in the lever arm is connected by a strap to an eccentric on the comb cylinder shaft. A cam may replace the eccentric to give an irregular movement. —B.C.I.R.A.

Spinning Spindle. T. A., H. A., and J. and T. Boyd, Ltd., Shettleston Iron Works, Glasgow. E.P.244,264.

The spindles of winding, spinning, twisting and like frames are provided with segments loosely mounted in a holder in a plane at right angles to the spindle and provided with serrations at their outer surfaces, so as to engage and drive the bobbins or tubes by centrifugal force. Pins mounted in holes engage slots in the segments to retain them in position. —B.C.I.R.A.

Ring Spindle Apparatus. J. S. Serra y Sió, Barcelona, Spain. E.P.244,328.

Rings are provided with eccentric shanks mounted in eccentric split holders so that they may be secured together and in the ring rail by a screw after they have been adjusted by relative rotation to the position that allows a centring member on the spindle to pass freely through the ring. —B.C.I.R.A.

Combing Machine Auxiliary Comb. J. Weinbrenner, Thann, Haut-Rhin, France. E.P.244,331.

An auxiliary comb is provided between the nipper and the feed roller to assist in retaining the fibre during the combing of the tuft and during the drawing-off. The

comb may be mounted on the upper nipper jaw and co-operate with a shoulder in the lower jaw or with a groove in that jaw. The comb may be formed integral with the upper jaw, or alternatively may be independent of the jaw and carried by a lever pivoted in a bracket on the lower jaw and controlled by a fixed member which engages a bowl at the end of the lower and gives the comb a movement analogous to the movement of the upper jaw. To assist in retaining the fibre the feed roller is preferably formed with peripheral and transverse grooves to provide numerous and pyramidal projections. The feed-roller may co-operate with a straight-edge behind it to cause the lap to pass round at least a quarter of its circumference.
—B.C.I.R.A.

Artificial Silk Spinning Machine Winding Mechanism. C. Hamel Akt.-Ges., Chemnitz, Germany. E.P.244,428.

The traverse guide of the winding mechanism of artificial silk spinning machines is operated so as to build cylindrical bobbins with conical ends by means of a heart cam which is driven by a pin on a disc fast on a shaft and is mounted on an eccentric bush rotated by gearing from the shaft.
—B.C.I.R.A.

Roller Drawing Head. G. and A. Leuze Ges., Reutlingen, Wurtemberg. E.P. 244,488.

In a drawing-head having four pairs of rollers, the rollers on each side of the drawing roller are weighted by a common saddle pivoted to a yoke controlled by a spring or weight. The saddle can be turned up to remove the weight from one roller so that it and the drawing roller can be cleaned, the weight remaining on the other roller. The drawing roller is small in diameter and self-weighted. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Preparatory Processes—

244,416. Sächsische Maschinenfabr. vorm. F. Hartmann A.-G. Process for worsted drawing.

244,715. A. Kämpf and K. Grunewalder. Retting process.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes.

Artificial Silk Warping Mill. *Silk J.*, 1925, **2**, No. 19, 41-42.

A special horizontal warping mill is described in which arrangements are made to secure even tension by building up each section in a reclining position across the face of the reel. For this purpose the separate staves of the reel are provided with an adjustable metal incline near the end; the sharpness of the angle of inclination depends on the length of the warp required. The design and method of warping with the mill are dealt with in fair detail.
—B.C.I.R.A.

Artificial Silk Warping Mill. H. Livesey, Ltd. *Text. Merc.*, 1925, **73**, 580-581.

The yarn is wound on small flanged bobbins which are placed on pegs on a movable creel. The ends from the bobbins are drawn through a lease reed and a guide reed and over a guide roller. The reeds and guide roller are carried on a positively controlled traversing carriage. The warp ends are secured to a hook under one of the staves of the mill and as it is revolved the warp is laid round it. On the right-hand end of each stave is placed a wedge-shaped guide and as the revolutions of the mill continue the warp is traversed outwards up these plates until the necessary length has been run on. A lease is then made and the ends secured. The reed carriage is moved inwards a distance equal to the width of the yarn already laid on and another section is laid on the mill, the inner slope of the first section taking the place of the wedges. The process is repeated until the correct number of ends has been laid. The near side of the machine is then brought into play to transfer the warp to a sizer's or weaver's beam. The machine could conveniently be used for the production of warps for the manufacture of the lighter fancy fabrics in cotton or worsted. —B.C.I.R.A.

(B)—Sizing

Artificial Silk: Sizing. *Silk J.*, 1926, **2**, No. 20, 43-44.

The method known as "bobbin to bobbin sizing," in which the yarn passes from bottle bobbins, flanged bobbins, cheeses, or cones, over a roller partially immersed in a sizing solution, to the same number of bobbins on the other side of the sizing roller, has entirely superseded "warp sizing" as used for cotton. Metal bobbins about 3 inches in diameter and with hollow, perforated barrels to allow the yarn to be dried both from inside and outside the barrel, are used. The bobbins are placed in drawers and dried in an ordinary stove. Typical size recipes are given and the operation of a beam warp sizing machine is briefly outlined. —B.C.I.R.A.

Steeped Flours: Mildew Liability. L. E. Morris. *J. Text. Inst.*, 1926, **17**, T.23-37. —B.C.I.R.A.

Sizing and Finishing Materials: Mildew Liability. L. E. Morris. *J. Text. Inst.*, 1926, **17**, T.1-22. —B.C.I.R.A.

Cholam Malt Extract: Diastatic Action. B. V. Nath and M. Suryanarayana. *J. Inst. Brewing*, 1925, **31**, 425-429.

A study has been made of the hydrolysis of starch by cholam (*Andropogon sorghum*)

malt extract and an explanation of the nature and mode of action of cholam diastase is offered. The available evidence points to the conclusion that two enzymes are concerned in the reaction, an amylase converting starch to dextrin and a dextrinase hydrolysing dextrin to maltose. The production of maltose is suppressed even if the malt extract is heated for half an hour at such a comparatively low temperature as 45° C. Increase in temperature results in further suppression of maltose production until at 85° C. practically no maltose is produced. No maltose production has been observed in the action of cholam malt extract on starch at 30° C. up to a period of one hour. Unlike barley malt, dextrins of lower specific rotation and higher cupric reducing powers are produced as a result of the action of cholam malt on starch paste. The dextrinase of cholam malt does not seem to hydrolyse dextrins until the degradation is sufficiently advanced. The production of maltose from starch by cholam malt appears to be the resultant of a series of reactions passing from one phase to another in regular sequence. —B.C.I.R.A.

(C)—Weaving

Pilling Artificial Silk Loom. H. Nisbet. *Silk J.*, 1925, **2**, No. 19, 54.

An improved type of check loom is described in which the outstanding feature is the perfect correlation of the shedding, picking, checking, and taking-up motions. If the loom stops automatically by the operation of the weft fork the pattern lag barrel of the dobby, shuttle box motion, picking sticks, and take-up motion are simultaneously and automatically put out of action and cannot resume their respective functions until after the depression of a vertical trigger connecting rod. A special picking device prevents shuttle accidents such as collisions in the warp shed or one shuttle being picked into a box already containing one. Improvements are embodied in the shuttle box and in the taking-up roller which is covered with special rubber filleting. —B.C.I.R.A.

Artificial Silk Weaving. A. L. Wykes. *Text. Mfr.*, 1926, **52**, 101-102.

An informative article describing the effects of tension and friction on artificial silk yarns during weaving, winding, and pirn winding. For all kinds of artificial silk yarn, the extensions produced by tensions less than one-half the breaking strain of the yarn are small; with higher tensions, the extensions produced are considerably greater. Artificial silk yarn stretches about 20% before breaking. The elasticity of artificial silk yarn is decreased by previous subjection of the yarn to high tension. The elastic properties of strained yarns are restored by wetting the yarn in water. —A.J.H.

Artificial Silk Loom. H. Nisbet. *Text. Rec.*, 1926, **43**, No. 514, 89-90.

A special feature of the machine is the way in which the shedding, picking, checking, and taking-up motions are correlated so that they operate in perfect unison. The picking motion is a modification of the cone pick of the ordinary plain loom. A special form of shuttle-box swell is employed and the shuttles are of special design. Many other notable features of the loom are mentioned. —B.C.I.R.A.

Picking Bands: Attachment. L. J. Mills *Text. Rec.*, 1925, **43**, No. 513, 55-56.

A short practical article on the attachment of picking bands on overpick looms. —B.C.I.R.A.

(D)—Knitting

Knitting. J. Chamberlain. *Text. Mfr.*, Jubilee Number, 1925, 161-171.

A general account of the progress of the knitting industry during the last fifty years. The principal stitches of modern knitting are described, and the machines on which they are produced. The auxiliary stitches, used for sewing and seaming knitted goods, are also discussed. —B.C.I.R.A.

Knitting Yarns. W. Davis. *Text. Mfr.*, 1926, **52**, 11-12.

Recent developments in the admixture of cotton with other materials are discussed and reference is made to the special characteristics required in yarns for the knitting industry. —B.C.I.R.A.

Knitted Fabrics: Application. A. B. Shearer. *Text. Merc.*, 1926, **74**, 13-14.

The effect of the development of knitted fabrics on the production of cotton cloth is discussed. In the home trade the characteristic elasticity of knitted fabrics makes them ideal materials for fine underwear and this demand is having a considerable effect on certain sections of the cotton trade, chiefly cambrics and lawns. The author is of the opinion that it will be a long time before the knitting industry has any considerable effect on the export trade of Lancashire. —B.C.I.R.A.

Circular Knitting Machine Patterning Mechanism. W. Davis. *Text. Rec.*, 1926, **43**, No. 514, 73.

The production of fancy designs on the latch needle circular frame is discussed. The tuck stitch is the general basis of the pattern, the tucking being performed by a wheel which works into the needle butts of the machine. —B.C.I.R.A.

Cardless Jacquard Flat-knitting Machine. J. B. Lancashire. *Text Rec.*, 1925, **43**, No. 513, 79.

A drum, built up of detachable metal strips cut to the gauge of the machine is used instead of jacquard cards. As yet, machines are only adapted to take two colours in the one course and designs are

restricted to those of a geometrical nature. A detailed description is given of the ingenious selector mechanism employed to control the drum. —B.C.I.R.A.

Knitting Machines: Development. E. F. Durand. *J. Text. Inst.*, 1925, **16**, P.368-374. —B.C.I.R.A.

PATENTS

Imitation Velvet Effect. Villard et Cognet. F.P.587,337.

For obtaining this kind of fabric, two shuttles are used; one uses a plain material, such as natural or artificial silk, chappe, cotton or metal, and weaves one or several picks of ground. The other uses textile yarns containing irregular or swelled parts or ondée. The second shuttle weaves one pick after three or four picks of ground. —Bur. Text.

Automatic Weft Changing Loom. M. Zattin. F.P.587,380.

The disposal, driven by the feeler or the fork, comprises a movable arm which, under the action of the feeler, is struck by the slay during its oscillation; a system of levels driven by the movable arm and acting as a hammer which pushes the cop into the shuttle; rods and levels actuating a ratchet which advances a tooth of a gearing driving the magazine. —Bur. Text.

Pleated Fabric Effect. Etablissements P. Staron. F.P.587,653.

An effect of zigzag or oblique pleated fabric is obtained by passing several pleating yarns by means of an auxiliary or swivel shuttle which weaves two picks, named lost picks, at each dropping of the weaving weft. —Bur. Text.

Artificial Silk: Sizing. A. Lauffs. D.R.P. 365,668 (from *Leipziger Monats. Text.-Ind.*, 1925, **40**, 182-183).

An improved method of sizing artificial silk consists in soaking the filaments without preliminary twisting in the size and allowing them to remain in contact with the size until no further absorption of size takes place as shown by tests on the residual size. —B.C.I.R.A.

Openwork Fabric Loom. F. Phily, Pau, Bassés-Pyrénées, France. E.P.243,340 and 243,341.

Special mechanism is described for the production of openwork fabrics having the warp threads formed into loops and the weft threads passed through the loops. The fabrics may be non-ravelling. —B.C.I.R.A.

Knitting Machine Bobbin. G. B. Collinge, Lees Road, Oldham, and Climax Machine Co., Stalybridge, Cheshire. E.P.243,404.

A collapsible bobbin for use particularly on knitting machines is made with the stem of four or more sections telescoping together on to a base cone. The yarn as it is wound presses on protuberances of springs which extend through slots in the sections. The springs thus bind the sections together. As the yarn is unwound, the sections are released in turn and drop. The lowermost section is attached to the base by a headed tube and locknuts. —B.C.I.R.A.

Shuttle Peg. N. N. Shreiber, Kilburn Lane, and F. W. Riches, Lissenden Gardens, London. E.P.243,476.

A two part shuttle peg is expanded and contracted by means of a member which is caused to slide on raising or lowering the peg by means of a pin on a link pivoted to the shuttle. Projections on the member are thereby caused to engage recesses in one or both legs when the peg is raised, so as to allow this to collapse, whilst they expand the peg when this is lowered. The peg members may be joined at their outer ends by welding or by a sleeve or ferrule. One of the peg members may be free at its inner end, its movement away from the other member being limited by a stop. The various parts may be of pressed or stamped metal. —B.C.I.R.A.

Loom Take-up Motion. J. A. & G. Huxley, Bakewell Street, Derby. E.P.243,488.

In means for causing the knee roller to reverse its motion to a predetermined extent and thereby bring the tape or other fabric closer to the reed to prevent the formation of spaces in the fabric caused by the starting or stopping of the loom, the wimsey spindle is formed in two parts, connected by a spring-actuated clutch, a brake disc on the female portion of the clutch being brought against a brake block when the clutch is disengaged and the loom is stopped. One part of the wimsey spindle is driven by worm gearing and the other part drives the knee roller spindle through bevel gearing. When a rod is moved to stop the loom, a lever shifts the driving belt on to the loose pulley, and an extension of the rod engages a lever to disconnect the clutch and move the brake disc into engagement with the block. The backward movement of the knee roller is controlled by a pawl and a toothed wheel on the spindle. —B.C.I.R.A.

Braiding Machine. E. Türck, Barmen, Germany. E.P.243,592.

The web is braided so that the selvages are caught round wires. In taking up the web, opposed rollers which work in depressions in the core or former, grip the web and permit the selvages to escape from the free ends of the wires. The web is drawn off the curved, flattened end of the core in flat form. —B.C.I.R.A.

Pile Fabric Loom Wire and Cutter Holder. Lox Seal Corporation, Brooklyn, N. York, U.S.A. E.P.243,669.

In pile wires for forming and cutting loops of warp thread, the walls of the U-shaped

holder for the cutter are welded simultaneously to one another and to the pile wire. —B.C.I.R.A.

Circular Knitting Machine Jacquard Mechanism. C. H. and C. S. Martin and S. and S. L. Kilbourn; Berridge & Co., Leicester. E.P.243,863.

Jacquard devices for acting upon sliding needles by means of feeler devices, &c., such as push pins and levers, are presented so that there is no rubbing contact between the jacquard band and the push pins. The band passes over bars and studded wheels on a spindle carrying a ratchet. The spindle is mounted in a frame fitted with slide bars which move in vertical ways. The frame is carried by an arm attached to a plunger which is moved up and down by a roll running in a cam track. When the frame is lifted the ratchet is turned by a pawl. When the frame is depressed a wheel with peripheral holes carried by the spindle, comes down on a fixed pin, and the engagement of one of the holes therewith ensures that the band and the push pins are in register. A number of jacquard devices may be used simultaneously. A cam system for operating the selected needles is described. —B.C.I.R.A.

Looms: Pneumatic Change-box Motion. P. & P. Schiapparelli, Genoa, Italy. E.P.243,961.

The frame carrying the drop shuttle boxes is connected by a fork to a vertical sleeve provided with vertical holes to receive rods attached to pistons operating in cylinders and actuated by compressed air introduced through pipes from a distributing chamber. Admission of the compressed air is regulated by a valve. The pistons have varied throws so as to raise the sleeve to a varied extent to bring any of the shuttles into action except one, which shuttle comes into action when no piston is raised. The cylinders, the sleeve and the frame are mounted on pivots so that they can oscillate, the compressed air pipes being flexible or provided with flexible joints. —B.C.I.R.A.

Shuttle Checking Mechanism. Hopedale Manufacturing Co., Milford, Mass., U.S.A. E.P.244,067.

Inertia means, consisting of a weighted arm fixed to the stop-rod, acts to vary the pressure of the usual binder fingers on the shuttle box swells in accordance with the degree of acceleration of the lay in its oscillation. It acts to ease the shuttle for picking, and, in a weft-replenishing loom of the bobbin-changing type, to facilitate bobbin transfer, and it acts to increase the binder pressure during boxing. A stop mounted on the hub of the inertia arm co-operates with a plate on the lay to prevent the overthrow of a second stop. A modification is also described. —B.C.I.R.A.

Shuttle-checking Mechanism. Blackburn Loom and Weaving Machinery Making Co. Ltd. and H. Starr, Eanam, Blackburn. E.P.244,226.

One end of a shuttle-box swell is engaged by a spring and the other end is mounted on an eccentric or otherwise connected to a weighted lever which rocks, due to its momentum, between stops at each stroke of the sley, and thus moves the swell into operative and inoperative positions. —B.C.I.R.A.

Warp Letting-off Motion. H. Northrop and B. Hartley, Colne, Lancashire. E.P.244,299.

The weighting ropes, &c., for the warp beam are connected to the notched short horizontal arms of two bell crank levers. One of the levers carries a two-armed curved lever, one arm of which supports a bowl on a weighted arm pivoted to an adjustable bracket on the loom frame. The bowl may be flanged and may be mounted on an adjustable or fixed stud. The other arm of the lever is connected by a threaded rod and adjusting nuts to the short arm of a curved releasing lever pivoted to the vertical arm of the other bell crank lever. The lever arm of the curved releasing lever normally engages a catch but can be released therefrom by the weaver, whereupon the weighted arm falls and takes the tension off the ropes, &c. The tension can be varied by means of the adjusting nuts and by moving the weighted arm or the weight. —B.C.I.R.A.

Loom Heald Mail; Manufacture of——. W. Braecker, Zurich, Switzerland. E.P. 244,381.

Mails for steel-wire healds are made from a metal strip by stamping out eyes at the required intervals and simultaneously or afterwards stamping out the mail ends. The strip is of the width required for the finished mail, its edges are V-grooved to receive the heald wires and it is of the same thickness as the heald wire. The spaces between the mails and the wires are filled with solder. The strip may be of copper, brass, or steel, and in the latter case the mails can be hardened. —B.C.I.R.A.

Bearded Needle Rib Frame Needle Loop Guard. J. Hearth & Co. Ltd. and C. H. Hearth, Leicester. E.P.244,585.

Bearded needle rib frames such as rotary frames of the "Cotton" type are provided with means for covering or guarding the rib needle loops from new loops falling from the sinkers, such as fingers let into grooves in the stems of the needles, or points held in a bar fixed between the needle plate and the needle carrier bar or mounted to move relatively to the needles. —B.C.I.R.A.

Ribbon Loom. C. Bilhartz, Strasbourg, France. E.P.244,706.

In a loom for weaving ribbons, &c., one or more reeds are carried by a lay, pivoted,

and oscillated by levers and grooved cams on a shaft, these cams being shaped to give a dwell to the lay, and whilst this occurs the shuttles are picked by fibre wheels actuated by wheels, a rack and a stud engaging a cam groove in a drum or cylinder on the shaft. The cam groove is formed to retain the stud stationary during half the revolution of the drum, &c., so that the shuttles are stationary whilst the beat-up occurs. The healds are connected to bars guided in vertical grooves and actuated by bell-crank levers linked to spring-controlled bars connected to cords. These cords are connected to fixed points and pass over pulleys on vertical levers operated by rollers on changeable supports in bars changeably mounted in grooves in a drum on a shaft furnished with a disc driven by bevel gearing from the shaft carrying the grooved cams. The shed is open for a comparatively long time. The shuttle is provided with means for stopping the loom in case of weft failure.
—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Weaving—

243,775. M. B. Lloyd. Shuttleless loom.

243,821. P. Venail. Vertical pile fabric loom.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming.

Wool Scouring in Theory and Practice. *Text. Rec.*, 1926, **43**, No. 516, 49-51.

A continuation of previous articles describing the scouring of loose wool in the type of machine usually employed.
—A.J.H.

(D)—Milling.

Milling (Wool) Routine. *Text. Mfr.*, 1926, **52**, 95-96.

Practical details of the milling of woollen fabrics are given, shrinkage of width being controlled by the throat and rollers, and shrinkage of length by the trap of the milling machine. —A.J.H.

(H)—Mercerising

Hank Mercerising Machine. Niederlahnsteiner Maschinenfabrik. *Text. Rec.*, 1926, **43**, No. 514, 88.

The machine has a simplified stretching appliance, a new method of impregnating and pressing out the lye and a simplified method of raising and lowering the lye basins which ensures a quiet movement. To economise in the use of lye, an automatic appliance is employed for catching the first cleansing water, which may be used again. To avoid shrinkage, spreader tubes are employed. —B.C.I.R.A.

One-side Fabric Mercerising. R. Sansone. *Text. Rec.*, 1926, **43**, No. 516, 59-61.

A continuation of a previous article, the necessary machinery being described
—A.J.H.

Cotton Skeins: Mercerising. *Text. Rec.*, 1925, **43**, No. 512, 69, No. 513, 69, and No. 514, 71.

Some general notes on efficient skein mercerising. —B.C.I.R.A.

(I)—Dyeing

Spray-dried Glauber Salt: Application. A. W. G. Wilson. *Text. Mfr.*, 1926, **52**, 27.

In Western Canada there are large deposits of natural Glauber's salt which is free from acid and iron. A process of drying has been developed in which a solution of the salt is filtered and sprayed into a chamber containing very hot gases. The resulting dry powder is light, fluffy, and weighs only 30 lb. to the cubic foot, so that transport is not prohibitive. It is more than double the strength of the usual product and dyeworks' chemists who have tried it find it unequalled. —B.C.I.R.A.

Dyeing. E. Clayton. *Text. Mfr.*, Jubilee Number, 1925, 139-145.

A general survey of modern dyeing practice.
—B.C.I.R.A.

Dyeing Cotton-Artificial-Silk Piece Goods. H. Blackshaw. *Dyer and Calico Printer*, 1926, **55**, 130-131.

The first part of an article dealing with cotton+viscose or cellulose acetate artificial silk woven fabrics. Owing to the low wet-strength of viscose silks they should be subjected to the minimum of tension and pressure during their treatment. Difficulties in dyeing cotton fabric containing viscose silk are due to the high dye absorptive power of the silk and the possibility of different grades of silk being present. In dyeing fabrics containing viscose silk pattern effects, it should be the object of the dyer to leave the silk slightly lighter in shade than the cotton ground, so that the pattern appears more lustrous. A number of suitable dyestuffs capable of giving the same shades on silks of different grades are given. —A.J.H.

Dyeing Cellulose Acetate. W. M. Todd. *Dyer and Calico Printer*, 1926, **55**, 126-127.

The conclusion of an article on the dyeing of cellulose acetate silks, particularly by means of Celatene dyestuffs. Celatene Red-Violet is exceptionally fast to light when dyed on cellulose acetate and Celatene Fast Light Yellow and Fast Light Brown almost equal it in this respect. Very fast to light shades of nigger brown may be obtained with Celatene Orange and Brilliant Violet B, while Celatene Yellow

and Black are the least fast. Celatene dyes are not recommended for mixtures of wool or silk with cellulose acetate since the animal fibres dye to moderate depths of shade, which, though fast to light, are loose to washing. Soledon colours have no affinity for cellulose acetate silk. Knitted goods may be easily printed by means of a paste containing Celatene dyes, a gum thickening and a soluble oil, the colours being fixed by steaming. —A.J.H.

Cellulose Acetate Silk. W. M. Todd. *Dyer and Calico Printer*, 1926, **55**, 112-113.

A general description of the physical and dyeing properties of cellulose acetate silk. —A.J.H.

Straw Bleaching and Dyeing: Modern Methods. C. Williams. *Dyer and Calico Printer*, 1926, **55**, 110-111.

A description of the application of the soluble (Soledon) vat dyestuffs to straw materials. —A.J.H.

Dyeing Artificial Silk. E. Greenhalgh. *Dyer and Calico Printer*, 1926, **55**, 106-107.

In dyeing viscose silk in bulk difficulty in matching shades is experienced because changes of shade occur in the subsequent process of drying. For instance, yellows of the stilbene or dehydrothiotoluidine type tend to come to the surface of viscose fibres to a greater extent than with cotton yarn during drying and reds similarly develop truer tones. Browns, which appear dull on cotton, approach to black on viscose, whereas bright browns on cotton develop rich shades on viscose. Blues which develop greener or redder shades on cotton after dyeing show this effect to a greater degree on viscose silk. The temperature of dyeing has a considerable effect on the resulting shade in the dyeing of compound shades on cellulose acetate silk. —A.J.H.

Sulphur Dye Resists. A. S. and J. Frossard. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 551-558 (Plis cachetés Nos. 1775, 1794, 1799, and 1813).

The production of white and coloured resist effects on fabrics dyed with sulphur dyes, using a mixture of manganese chloride and zinc oxide is described. In the referees' report attention is drawn to a patent of the Cassella Co. using the same principle, but the present notes are said to give the first details. The fixation of basic colours by means of zinc tungstate is also described and no previous mention of this process has been found. —B.C.I.R.A.

Sodium Silicate Vat Dye Pastes: Application. La Manufacture Emile Zundel and Louis Lantz. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 559-561 (Pli cacheté No. 2088).

It is proposed to replace alkali carbonates in the printing of vat dyes by sodium silicate in a solution of 35° Bé. The results are said to be more satisfactory than when potassium carbonate is used. —B.C.I.R.A.

Process for Dyeing Woollen Piece Goods Evenly: Process for Printing Woollen Piece Goods by Means of Direct Dyestuffs without Steaming. C. Favre. *J. Soc. Chem. Ind.*, 1926, **45**, B.122 (from Sealed Notes (A) 1897, 2/4/09, and (B) 2120, 20/9/11.. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 618 and 619-620. Report by H. Wagner, *Ibid.*, 620-621).

(A) Uneven dyeing of woollen piece goods in a winch machine is avoided by retarding the rate of absorption of dyestuffs by the following method—The pieces are entered into a cold dye-liquor containing sodium carbonate, the temperature of the dye-liquor is then raised 30° and sufficient sulphuric acid to reduce the alkalinity to one-half is added, the pieces at this stage being merely tinted. At 35° the dye-liquor is made slightly acid by addition of a further quantity of sulphuric acid, whereupon dyeing proceeds rapidly. Subsequently dyeing is continued at boiling temperature, the dyed pieces being afterwards washed and dried. For the drying of nine pieces (each 45 yds. in length) of woollen delaine, a dyebath containing 122 g. of Tartrazine, 125 g. of Lanafuchsine SB, 68 g. of Cyanine B, and 8 kg. of sodium carbonate is used, two successive additions, each of 4 kg. of sulphuric acid of 65° B (*d.* 1 : 82) being made.

(B) Woollen pieces are padded with a thickened dye-liquor containing a direct dyestuff and a small quantity of sodium chloride, then dried, and successively passed through two acid baths, the first containing a cold and the second a hot (80°) 0·5% solution of sulphuric acid, and afterwards washed and dried; the duration of immersion in each acid bath is ½ min. The resulting shades are particularly even. Suitable padding liquors contain 80 litres of water, 20 litres of dextrin thickening, 1 kg. of salt, and 130 g. of Diamine Fast Blue FFB (C), 8 g. of Benzo Fast Red 8DL (By), and 52 g. of Diamine Yellow CP (C), or 350 g. of Diamine Fast Blue FFB, 80 g. of Brilliant Fast Blue 4G (By) and 8 g. of Diamine Yellow CP. Wagner confirms the advantages claimed for these processes. —B.R.A.W. & W.I.

Cellulose Acetate Silk: Theory of Dyeing. V. Kartaschoff. *Helv. Chim. Acta*, 1925, **8**, 928-942.

The physical properties of cellulose acetate silk are discussed in relation to its dyeing properties. It is not very permeable to water, a fact which is explained by its low porosity. It has no crystalline structure and it may be regarded as a solid colloid. The colloid has a negative electric charge which, however, plays no part in the dyeing process. Cellulose acetate

silk may be dyed merely by immersion in a suspension of basic anthraquinone dyestuffs in water, suggesting that the dyeing process is one of simple dissolution of the dye by the collodial fibre. This point of view was confirmed by keeping dry fibre and dry, powdered dianisidine in contact for some days at 60°. After 15 days the artificial silk had acquired a permanent dark brown colour and it is concluded that the dyeing of cellulose acetate is a simple process of solution of the dye by the fibre in which water may play a favourable but not an indispensable part. —B.C.I.R.A.

Utilisation of Waste Dyewoods. See Section 9.

(J)—Printing.

Calico Printers Accounts: Special Features of. S. H. Withey. *Dyer and Calico Printer*, 1926, **55**, 134-135.

A description of a costing system suitable for calico printers. —A.J.H.

Developments in Calico Printing. R. Sansome. *Dyer and Calico Printer*, 1926, **55**, 132-133.

Apparatus and methods for printing and discharging sulphur colours on cotton fabric are described. —A.J.H.

Printing Woollen Piece Goods. See Section 4 I.

(K)—Finishing

Cellulose Solutions: Application. *Dyer and Calico Printer*, 1926, **55**, 7 (from *Yorkshire Evening Argus* and the Lancashire correspondent of *Fairchild's Journal*.

Cotton fabrics are ornamented with liquid artificial silk by means of fabric printing rollers carrying the required designs. Those parts of the fabric which are covered by the solution have a translucent appearance, and when viewed from a distance the pattern is similar to that of a woven design though the scope of the designs is in some instances beyond that of weaving. Those parts of the fabric on which the cellulose solution falls are 20% stronger than the untreated parts. The finish is said to be permanent and unaffected by laundering, and it can be applied at a fraction of a penny a yard where large quantities are to be dealt with. —B.C.I.R.A.

Scroopy Cotton Fabric: Preparation. C. Sunder. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 561-562.

A scroopy effect can only be produced on cotton which has been finished with a starch finish. Sodium soaps prevent the production of a scroopy finish whilst triglycerides are necessary. The finishing mixture should contain coconut butter, which is preferably made into an emulsion with oleic acid and caustic soda. If the cloth has been soaped, ammonium chloride must be added to the finishing mixture containing the emulsion. The ammonium chloride, however, changes the shade of dyed pieces and in its presence it is better to replace ultramarine in the finishing mixture by indanthrene. —B.C.I.R.A.

Fireproofing Textiles. *Dyer and Calico Printer*, 1926, **55**, 60.

A process for fireproofing textile materials by deposition within them of alumina. For example, fabric is impregnated with a solution containing sodium aluminate and sodium carbonate, dried, passed through a hot concentrated solution of sodium bicarbonate, treated with a boiling solution of sodium carbonate, washed and dried. —A.J.H.

Patents

Crepe Fabrics: Preparation. H. Dreyfus. F.P.584,855 (from *Chem. Zentr.*, 1925, **ii.**, 2327).

Regenerated cellulose threads are coated with a protective dressing of boiled-off liquor ("Bastseife"), solutions of gelatin or starch, &c., strongly twisted, partially or wholly freed from the dressing, and treated with media for producing crepe effects. —B.C.I.R.A.

Machine for Opened Lists. Etablissements Pellaumail, Monteil et Co. F.P. 587,367.

This machine makes mechanically-opened lists for handkerchiefs, &c., and comprises two blades or knives moved vertically with alternate motion. One blade cuts a certain number of yarns of the fabric (either in the warp or in the weft); the other drives out the lists of the cut yarns. For this cutting, the fabric ought to be well stretched. —Bur. Text.

Finishing Compound: Preparation. G. L. Brugère. F.P.592,205 (from *Chem. Zentr.*, 1925, **ii.**, 2327).

A mixture of an aromatic amino- or hydroxy-carboxylic acid, formaldehyde and ammonia is heated in a closed vessel to 90 or 150°. A viscous mass is obtained which on standing in the air is gradually converted to a gel. For finishing purposes a colloidal suspension in an organic solvent is used and the strength of the fibre is increased by the treatment. —B.C.I.R.A.

Aldehyde Soaps. R. Vidal. F.P.594,146 (from *J. Soc. Chem. Ind.*, 1926, **45**, B166.).

Oils, fats, and waxes are treated with alkali hydroxides in the presence of aldehydes such as furfuraldehyde. The soaps obtained are specially suitable for brightening sulphur dyes. —B.L.R.A.

Treatment of Cellulose Esters for Dyeing. R. Metzger. U.S.P.1,532,427 (from *Chemicals*, 1925, **24**, 21).

The affinity of cellulose acetate for dyestuffs may be increased by soaking for an indefinite period in cold or hot baths of

"salts of acid esters of mineral oxygen acids" such as potassium ethyl sulphate, sodium dicresyl phosphate and similar borates. Examples given are—(1) 10 kg. acetate cellulose soaked for ten minutes at 50-60° C. in a bath of 300 litres of 50% (by weight) of potass. ethyl sulphate, with a little acetic acid, wrung, stretched, and dyed without rinsing in 1% Diamond Green B, slightly acid, at 40-70° C.; (2) 1 kg. acetate is worked for ten minutes hot or cold in 30 l. of 5-6% sodium dicresyl phosphate, then wrung, stretched, and dyed in 0·8% Methyl Violet 2B extra at 40-70° C. It is not stated if such dyeings are fast to light. —F.G.P.

Base Exchange Water Softener. O. R. Sweeney, Assr. to Ward-Love Pump Corporation. U.S.P.1,557,117 (from *J. Soc. Chem. Ind.*, 1926, **45**, B110.

An apparatus for water softening by the base exchange process consists essentially of a container for water softening material, provided with a diaphragm having extremely fine interstices, e.g., filter cloth composed of fine non-corrodible wire fabric, or a "filtros" plate, for uniformly distributing the flow of water or brine solution over and to the face of the base exchange material. —B.R.A.W. & W.I.

Linen Finish on Cotton Fabrics. E. R. Clark. U.S.P.1,564,963 (from *Chem. Abs.*, 1926, **20**, 511).

Cotton fabric is impregnated with a viscose solution of low alkalinity, the excess solution is removed, and the cellulose precipitated on the fabric by the use of sulphuric acid or other precipitating agent. —B.L.R.A.

Liquid Chlorine Bleach Liquor: Preparation. G. Braam. G.P.316,797 (from *Zellstoff u. Papier*, 1925, **5**, 485).

An apparatus for the preparation of bleaching solutions from liquid chlorine has two containers, one above the other, connected by a pipe. The lower vessel is filled with water or a dilute solution of caustic soda and gaseous chlorine is led in, just above the level of the liquid, from the cylinder. The pressure of the gas forces the liquid through the connecting pipe into the upper container, a manometer showing when a definite volume of chlorine at a definite pressure is contained in the lower vessel. A stirrer is then set in motion, the gas is absorbed and the liquid flows back into the lower vessel. By this means a hypochlorite solution of definite composition is obtained and there is no difficulty in measuring the amount of chlorine absorbed. —B.C.I.R.A.

Bleaching Wool. Chem. Fabr. Griesheim-Elektron, Assees. of L. Löchner. G.P. 415,583 (from *J. Soc. Chem. Ind.*, 1926, **45**, B11).

Wool is bleached by treating it for 2 to 5 minutes with cold or warm solutions of sodium bisulphite of 0·5 to 1·0 B. (*d.* 1·003-1·007), then removing excess of solution and drying. —B.R.A.W. & W.I.

Paper Machine Drier Felts: Finishing. E. D. Walen, Watertown, Mass., U.S.A. E.P.241,560.

Cotton drier felts are treated with a mixture of sodium silicate and a soluble oil dissolved in water to lubricate the fibres and to provide an alkali in the felt which will neutralise the acid which accumulates in concentrated form by the evaporation of the pulp water, thus prolonging the life of the felt. The solution may be applied to the yarn before weaving and is preferably used at a temperature of 60° F. —B.C.I.R.A.

Aluminium: Application. Raduner and Co. A.-G., Thurgau, Switzerland. E.P. 241,851.

Aluminium is used for those parts of apparatus that come into contact with the hypochlorite or hypochlorite solution in processes in which hypochlorites, and particularly bleaching powder, are utilised. —B.C.I.R.A.

Cellulose Acetate: Fireproofing. A. Eichengrün, Charlottenburg, Berlin. E.P.243,350.

Artificial silk is prepared from solutions of acetone-soluble cellulose acetate, or from mixtures of acetone- and chloroform-soluble cellulose acetates which have been prepared with the addition of methylene chloride. This lowers the flash point of the solution and solvent mixtures may contain up to 30% of alcohol, acetone, ethylene chloride, &c., without being inflammable. —B.C.I.R.A.

Yarn Mercerising Machine Stretching Mechanism. W. Koenigs and J. Kam, Crefeld, Bockum, Germany. E.P. 243,380.

In mercerising double or multiple threads, the stretching by which the lustre is produced after treating with mercerising liquid is effected in the wet twist frame between the passing off of the thread and its arrival on the twisting spindle. The threads, degreased and treated with lye, are unwound from the spools, passed through rollers, washing troughs, rollers, acid troughs, and washing troughs and are wound on the spindles. The stretching takes place between the two sets of rollers, the speed of the second set being adjusted to stretch the yarns to their original length. —B.C.I.R.A.

Fabric Rolling Machine Guiding Device. F. A. Bernhardt A.-G., Zittau, Germany. E.P.243,697.

A guiding device for a machine for rolling up fabrics comprises two rods or rollers, one above and one below the fabric, so mounted as to be capable of simultaneous displacement relatively to the fabric. The rollers are pivoted at one end in fixed bearings and at the other in a disc or slide

which can be adjusted by worm, &c., gearing. —B.C.I.R.A.

Drying Machine. J. E. Alexander, Port Edwards, Wisconsin, U.S.A. E.P. 243,762.

A method of drying materials such as paper consists in the application of radiant heat to the material in a chamber from which air is excluded by the higher pressure of the gaseous medium removed from the material within the chamber, the percentage of moisture remaining in the material at the end of the drying operation being controlled. A web of the material to be dried is fed into a housing and threaded through the drier on Fourdrinier wires supported on breast rolls at each end and by rollers at intermediate points. Allowance is made for expansion and contraction; the breast rolls at one end of the machine are mounted in carriages running on rails. The interior is divided by baffle plates which extend transversely between the passes of the drier. The web is entered and withdrawn through sliding door members positioned to allow narrow openings. The drying is effected by a series of electric heating elements beneath each path of the wires, the elements being adjustable by links and cranks, whereby the heating effect is controlled. The breast rolls bearings are water-cooled. The steam generated displaces the air from the housing. —B.C.I.R.A.

Cellulose Acetate: Dyeing. British Celanese, Ltd., London, and G. H. Ellis, Spondon, Derby. E.P.243,841.

The fastness to light of dyeings, printings or stencillings on threads, yarns, fabrics, films, or other products of or containing cellulose acetate is improved by an after-treatment of the treated goods with one or more simple amino or substituted amino compounds, such as aniline, alkylanilines and alkylphenylenediamines, for example, tetraethylphenylenediamines. The amines may be applied in aqueous solution in the form of the free base or soluble salt such as hydrochloride, or they may be solubilised by pre-treatment with the solubilising agents of Specifications 219,349; 224,925; 242,393; and 242,711. It is preferred not to use amines which are susceptible to air oxidation such as diphenylamine, *p*-aminophenol and *p*-phenylenediamine. The invention is particularly applicable to goods which have been coloured with azo dyes. An example shows the treatment of a cellulose acetate knitted fabric dyed with benzene azo-α-naphthylamine with aqueous diethylaniline hydrochloride. —B.C.I.R.A.

Textile Materials: Bleaching and Washing. H. Kohnstamm & Co. Inc., New York, U.S.A. E.P.243,877.

Textile materials after being bleached, as with chlorine or hypochlorite, and washed, [illegible] oxalic acid, citric acid, benzoic acid, or hydrochloric acid, and with a metallic salt having a reducing action due to the metal. Specified sours are acetic acid, sulphuric acid, phosphoric acid, tartaric acid, sodium hydrogen sulphate, sodium silicofluoride, or other soluble acid compound of fluorine with or without a proportion of oxalic acid, and mixtures of two or more of the above. In an example 90 lb. of sodium silicofluoride and 10 lb. of stannous or titanous chloride are used. —B.C.I.R.A.

Drying Machine. H. Haas, Lennep, Rhineland, Germany. E.P.244,043.

In drying apparatus for textiles and the like with alternate sequence of drying chambers and air heating chambers, separate fans are located over each heating chamber to exhaust the air from the drying chamber and force it into the heating chamber from whence it returns in part to the same drying chamber and in part proceeds into an adjacent drying chamber in progression from the air inlet to the outlet. —B.C.I.R.A.

Cellulose Acetate Silk: Printing. British Celanese, Ltd., London, G. H. Ellis and E. Greenhalgh, Spondon, Derby. E.P. 244,143.

Threads, yarns, fabrics, &c., of cellulose acetate are printed or stencilled by means of insoluble or relatively insoluble colouring matters, compounds, or components, for example, those referred to in Specifications 219,349; 224,681; 224,925; 227,183; and 237,943, solubilised by treatment with the solubilising agents of Specifications 219,349 and 224,925, the printing or stencilling preparations containing in addition one or more swelling agents having a solvent or latent solvent action towards cellulose acetate, such as thiocyanates of alkali metals or of ammonia (particularly for neutral or alkaline preparations), zinc chloride or nitrate, and salts of organic sulphonic acids such as those of benzene, naphthalene, or anthracene or of their substitution derivatives, for example, naphthol, phenol or aminonaphthols. In an example, a bluish-red shade is obtained on a cellulose acetate silk fabric by printing on a colour containing 2·4-dinitrobenzene-1-azo-dimethyl-aniline solubilised by pre-treatment with sodium sulphoricinoleate, soda ash, ammonium thiocyanate, and a thickening of British gum and gum arabic. —B.C.I.R.A.

Cellulose Acetate: Preparation. J. O. Zdanowich, Westminster. E.P.244,148.

In a process for the acetylation of cellulose involving in the first stage the chlorination of the acetylation mixture, the free chlorine intentionally left in solution is utilised to form in the second stage of the acetylation a nascent condensing agent, for example, by the passage into the [illegible]

oxide, or an oxide of phosphorus. Working in this manner the use of a strong condensing agent such as sulphuric acid may be dispensed with, but it is permitted to complete the acetylation by a third stage in which a very small amount of a strong condensing agent is added, for example, 0·01-0·1% of sulphuric acid. —B.C.I.R.A.

Fabric Stretching Apparatus. C. Taylor, Wappengers Falls, N.Y., U.S.A. E.P. 244,371.

Apparatus for stretching fabrics, more particularly for use in mercerising machines, comprises a number of cylindrical scrolls of the kind having spiral grooves extending from the centre to each end, these scrolls being arranged in an arcuate or circular row with unoccupied spaces between them and being driven to rotate about stationary axes or to revolve about a common axis or to rotate and revolve, tension rollers being arranged at both sides of the row to retain fabric passing over the rolls in tension therewith. —B.C.I.R.A.

Singeing Machine Cylinder: Heating. W. Osthoff, Barmen, Germany. E.P. 244,429.

The cylinder of a singeing machine is externally heated by an oil-containing fuel whereby the cylinder is coated with a fine trace of oil or graphite and oxidation and consequent pitting of the singeing surface is prevented. —B.C.I.R.A.

Linenised Cotton Materials: Finishing. H. Matt, Bregenz, Austria. E.P.244,485.

Cotton yarns not exceeding 60's counts, and fabrics made therefrom, are given a linen-like appearance by treatment with sulphuric acid not above 50·5° Bé. for a period of four minutes or more, and after washing, mercerising them under tension with caustic lye above 15° Bé. at a temperature above 0° C. The sulphuric acid may be cooled to prolong the action and the treated material may be calendered. —B.C.I.R.A.

Artificial Silk: Dyeing. British Enka Artificial Silk Co., London. E.P.244,496.

The dyeing properties of artificial silk are modified after manufacture by adjusting the proportion of non-cellulose substances in the finished material. Thus, the absorbing power for dyestuff is increased by increasing the proportion of oxycellulose present as by heating the silk in air, &c., or by treatment with an oxidising medium, whilst it is decreased by removal of the oxycellulose, hemicellulose, or hydrocellulose as by treatment with hot glycerol. In examples, viscose silk is rendered less absorbent to Methylene Blue and Diamond Fuchsine by first heating at 150° C. with glycerol, and more absorbent by preliminary treatment with sodium hypochlorite solution. —B.C.I.R.A.

Fabrics and Fibres: Fireproofing. T. J. I. Craig and P. Spence & Sons, Ltd., Manchester. E.P.244,503.

Fabrics, fibres, &c., are fireproofed by successive treatment with a solution of alkali aluminate and carbon dioxide, and the proofing matter is fixed by immersion in a boiling or nearly boiling solution which under atmospheric pressure has a boiling point over 100° C. The carbon dioxide may be in gaseous form or in combination, e.g., as alkali bicarbonate. Sodium carbonate, common salt, potassium chloride, and sodium sulphate are mentioned as suitable salts for the fixing solution, which may contain a relatively small proportion of acid alkali carbonate. —B.C.I.R.A.

Calico Printing Machine. E. Cadgene and G. Dupont, New Jersey, U.S.A. E.P. 244,608.

In printing fabrics, the separate characteristics of a composite ornamentation are printed during one running of the fabric through the machine by separate printing members, one of which comprises a thin perforated stencil producing a bas-relief ornamentation, such as a dotted or other outline, and another an ordinary printing member producing a flat ornamentation. —B.C.I.R.A.

Starch-calcium Chloride-borax Compound: Preparation. Henkel & Cie Ges., Dusseldorf, Germany. E.P.244,708.

Eighty-five parts of crystalline calcium chloride in 15-20 parts of water are slowly added to 100 parts of potato starch. When the paste begins to thicken, up to 2 parts of borax are stirred in. The borax may also be crushed with the dry halogen-calcium-starch preparation. The products may be used as adhesives or dressings. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Drying and Conditioning—

243,509. S. C. Bullen. Drying cylinders.

Bleaching—

243,360. E. C. Duhamel and Cie. Gen. des Ind. Text. Bleaching and washing process for wool, silk, &c.

Dyeing—

243,359. A. Manzoni and E. Muller. Atomising device for dyeing yarns and fabrics.

243,737; 243,738. Farb. vorm. Meister, Lucius and Brüning. Processes for dyeing cellulose esters and ethers.

244,267. British Dyestuffs Corporation, W. H. Perkin, and C. Hollins. Dyeing Process for cellulose acetate.

Finishing—

244,282. A. Bloxam. Liquid treatment for silk in hank or piece.

5—LAUNDERING AND DRY CLEANING

Patents

Detergents: Preparation. Badische Anilin and Soda-Fabrik, Ludwigshafen-on-Rhine, Germany. E.P.244,104.

Cleansing compositions not decomposed by hard water or acids and especially suitable for treating textiles, comprise an aromatic sulphonic acid having more than ten carbon atoms in the molecule and not hydrogenated in the nucleus, and higher aliphatic alcohols. When the sulphonic acid has a tanning character and is capable of precipitating glue from its acid solution, one or more hydro-aromatic alcohols may be substituted wholly or in part for the higher aliphatic alcohols. Water, hydrocarbons, or other organic compounds soluble in water only with difficulty may be added. Alcohols specified are butyl, isobutyl, heptyl, octyl, their homologues or mixtures. In an example, 3 lb. of the sodium salt of isopropyl beta-naphthalene-sulphonic acid are dissolved in 7 lb. of water and mixed with 3 lb. of a mixture of alcohols boiling between 145 and 165° C. obtained by the catalytic reduction of carbon monoxide and fractional distillation. For use the viscous liquid is dispersed in water. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Laundering—

243,465. British - American Laundry Machinery Co. Ironing machine with pressing action.

243,814. British - American Laundry Machinery Co. Washing machine with closed rotary receptacle.

243,989. C. G. Sinclair. Washing machine.

243,993. Cherry Tree Machine Co. Ltd. Washing machine and driving gear.

243,026; 243,027. British - American Laundry Machinery Co. Washing Machines: Stop mechanism and process indicator.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Becke's Colour Theory. M. Becke. *Melliand's Textilberichte*, 1925, **6**, 501-502, 596-600, 676-680, and 753-756.

A further explanation of Becke's natural colour theory. Some erroneous impressions arising from Lauterbach's lecture on the subject are corrected, and the practical value of the theory is emphasised. —B.C.I.R.A.

Dyed Fabrics: Tendering by Perhydrol. R. Haller. *Leipziger Monats.*, 1925, **40**, 18-20.

Further experiments on the action of a 30% solution of hydrogen peroxide (Merck's "Perhydrol") at room temperatures and in diffused daylight, on dyed cotton fabrics are described. The fabrics were dyed with indigo and its halogen derivatives. Fabrics dyed with the chlorinated indigos are more susceptible to oxidation than similar fabrics dyed with indigo or its bromo- or chlorobromo-derivatives. Fabrics dyed with 6-6[1] halogen indigos are remarkably resistant to attack. Bromo- and chlorobromo-derivatives have a negative catalytic effect on this reaction. —B.C.I.R.A.

Analysis of "Sil." *Seifensieder Zeitung*, 1925, **52**, 604.

Analysis of "Sil" bleaching powder, made by Henke & Co.—

Na_2CO_3	55·35%
Active oxygen	4·90%
Water free sodium silicate	8·24%
Calcined Na_2SO_4	3·30%
NaCl	2·05%
Water (approximately) ...	26·0 %

Oxygen present as percarbonate. —B.L.R.A.

Uganda Cotton: Spinning Tests and Measurable Characters. *Empire Cotton Growing Review*, 1925, **2**, 215-223.

The details of spinning tests and laboratory examination on five Uganda special selections from the Government Farm, Serere, Uganda, and on a sample of Quande from Sierra Leone are given. —B.C.I.R.A.

Why Clothes Shrink and Fade. *Dyer and Calico Printer*, 1926, **55**, 77.

The popular belief that dyed woollen goods are faster to light than worsted goods is false, except in the case of woollen goods of high quality; dyed woollen goods of low quality are much less fast to atmospheric agencies. It is impossible to obtain perfect non-shrinking material and the majority of worsted fabrics are shrunk as far as possible with soap during their preparation for dyeing. The practice of pleating woollen goods for women's wear demands dyestuffs fast to wet steaming rather than dry steaming; Coomassie Navy Blue, Cloth Fast Blue, Erio Fast Blue, and Fast Purple dyes are not fast to pleating, although fast to dry steaming. Although fastness of dyestuffs to perspiration is usually determined by means of acetic acid, the perspiration of some people is alkaline. —A.J.H.

Oiled Artificial Silk Threads: Testing. W. Whittam. *Silk J.*, 1926, **2**, No. 20, 57.

The results of some tests on two cones of 150 denier artificial silk which had been treated with a neatsfoot oil solution are recorded. Tests were made to determine the percentage of oil used, based on the weight of the thread, and secondly whether the thread showed any appreciable loss of weight by evaporation of the oil when skeins taken from the cones were exposed

to a relative humidity of 65% at 70° F. for ten days. The oil contents, determined from sample skeins reeled from the outside of each cone were 6·94 and 6·16% and the corresponding oil contents of sample skeins reeled from approximately the middle part of each cone were 6·32 and 7·46%. The thread had, therefore, been fairly uniformly treated. Under the described experimental conditions little loss by evaporation of the oil was found. —B.C.I.R.A.

Flowmeter; A Ball and Tube——. J. A. Ewing. *Science Abstracts*, (A) 1926, **29**, No. 8 (from *Proc. Roy. Soc.*, Edinburgh, 1924-1925, **45**, No. 3, pp. 308-321).

An apparatus is described consisting of a tapered glass tube holding one or more steel spheres which can be used to determine the rate of flow of a liquid through the tube. It is shown that the instability which sets in when the tube is vertical, or nearly so, can be avoided best by sloping the tube at about 30°. The nature of the motion near the sphere was exhibited by a narrow jet of coloured liquid. The sustaining force for the sphere is due to two effects depending upon the density and viscosity of the liquid, and a series of tests is described, using liquids of the same density but different viscosity, to determine the relation of the two forces. Applications of the apparatus in practice are explained. —L.I.R.A.

Malt Amylase: Saccharifying Power. T. Sabalitschka and C. Schulze. *J. Soc. Chem. Ind.*, 1925, **44**, B936 (from *Fermentforsch.*, 1925, **8**, 428-448, 449-463, 464-473).

Dextrin is estimated by comparison of the colour produced on addition of iodine with a series of 18 improved standard colours. Maltose is determined by oxidation with hypoiodite after precipitation of interfering polysaccharides with alcohol. Filtration or 24 hours' standing has no effect on the activity of amylase solutions. Dextrin formation and maltose formation from starch are considered not to be brought about by two separate enzymic constituents of amylase, since these functions are affected equally by partial adsorption of the enzyme by different adsorbents. Lime-wood charcoal, "charcoal sponge," kieselguhr, animal charcoal, kaolin (in dilute sulphuric acid) and aluminium hydroxide exhibit increasing efficiency in adsorbing malt amylase. When amylase is completely removed from solution by adsorption the dextrorotation of the solution remains unchanged; hence amylase is optically inactive. Caffeine in concentrations up to 0·3% and sulphonal up to 0·06% have no action on amylase. Formaldehyde activates slightly up to 0·02% and inhibits above 0·06%. Acetaldehyde and propaldehyde inhibit above 0·06%. No differential action with regard to maltose and dextrose formation was observed. —B.C.I.R.A.

Oxygen: Determination of Dissolved, by the Winkler Method. E. J. Theriault. *Analyst*, 1925, **50**, 632-633 (from *U.S. Public Health Bulletin*, 1925, No. 151).

A procedure is described in detail for the determination of dissolved oxygen in water by the Winkler process and is essentially the same as the Rideal-Stewart modification of this process.

Methylation of Polysaccharides. L. Schmid. *J. Chem. Soc.*, 1925, **128**, i., 1386 (from *Berichte*, 1925, **58**, 1966-1968).

Cellulose does not react with diazomethane. Lichenin, inulin, and soluble starch scarcely react with diazomethane in anhydrous ether, but become methylated if water is added in small quantity. Starch yields two fractions, separable by alcohol, containing respectively 21·51% and 22·24% OMe; methylation proceeds therefore beyond the monomethyl stage, but more highly methylated derivatives cannot be obtained. Similarly, lichenin affords apparently a monomethyl-lichenin (17·37% OMe) insoluble in alcohol and a soluble fraction containing 21·62% OMe. Inulin yields a product with 25·24% OMe equivalent to three methoxyl groups for two $C_6H_{10}O_5$ residues. The methylated compounds do not reduce Fehling's solution. —L.I.R.A.

d-Glycuronic Acid. F. Ehrlich and K. Rehorst. *J. Chem. Soc.*, 1925, **128**, i., 1379 (from *Berichte*, 1925, **58**, 1989-1992).

Menthylglycuronic acid is hydrolysed with dilute sulphuric acid at 100° and the menthol is removed. The solution is treated with an excess of barium hydroxide or carbonate and, after removal of barium sulphate, is concentrated and treated with alcohol, whereby barium glycuronate is precipitated. The salt is decomposed by rather less than the calculated quantity of sulphuric acid and to the filtrate after removal of sulphate, a large excess of alcohol is added. After filtration from a small amount of barium glycuronate and concentration, *d-glycuronic acid*, $C_6H_{10}O_7$, melting point 154°, $[\alpha]^{24}_{D}+11{\cdot}73°$ to $+36{\cdot}26°$ in water is obtained. The positive mutarotation indicates the existence of α-and β-modifications of the acid. The acid is transformed in boiling aqueous solution into the corresponding lactone.—L.I.R.A.

Elastic Hysteresis and Internal Stresses in Bent Rock-salt Crystals. M. Polanyi and G. A. Sachs. *Science Abstracts*, (A), 1926, **29**, No. 20 (from *Z. fur Physik.*, 1925, **33**, 692-705).

Deals with variations of the limits of elasticity of rock-salt under normal temperature conditions and when heated 600° C. These limits are found to be 500 grs. and 200 grs. per sq. mm. respectively. It is shown that, before rupture occurs, a change of form results. With plastic deformation elastic hysteresis effects occur and the resulting variations

are not proportional to the stress. In plastic strained crystals movements of the surface layers occur, demonstrating the existence of internal stresses, the nature of which is discussed. —L.I.R.A.

Wool Fabrics by the Sense of Touch; The Discrimination of——. W. H. Binns. *Brit. J. of Psychology*, 1926, 16, 3.

A range of fabrics of similar construction was made from several different types of wool. These were judged by experts in various branches of the trade and also by intelligent persons (teachers, &c.) without trade knowledge. The points judged were softness ("handle"), appearance ("smartness"), and commercial value. The average of untrained judgment agreed remarkably with the trained but there was less "decision" or certainty, i.e., the correlation of the individual judgment with the average was lower. Training appears to raise the correlation or decision about 20%. The tests were also applied to young persons or children at school, and indicated that it might be possible to separate those who would improve with training from those who would be unlikely to succeed in such trades as wool sorting, cloth buying, &c.

Cellulose, Wood, and Starch: Distillation. H. E. Fierz-David and M. Hannig. *Helv. Chim. Acta.*, 1925, **8**, 900-923.

The dry distillation of cellulose, wood, starch, or lignite does not appear to be influenced by the presence of hydrogen at 300 atmospheres pressure. In the presence of nickel oxide and hydrogen, giving finely-divided nickel, the decomposition of these substances is complete and the yield of gaseous and liquid products is almost quantitative. Copper is much less effective and iron is without effect. Gas-coals yielded unfavourable results. The most important products obtained from the substances indicated are aromatic phenols, chiefly homologues of xylenols, guaiacol, &c., liquid organic acids from formic to valeric acids, numerous diketones, very few ketones, numerous alcohols including methyl alcohol, a cyclic glycol, several homologues of furane, and carbon monoxide, carbon dioxide, and water. —B.C.I.R.A.

Nitro Compounds: Estimation. I. M. Kolthoff and C. Robinson. *Rec. Trav. Chim.*, 1926, **45**, 169-176.

A method is described by means of which aromatic nitro substances are rapidly reduced at room temperature by a slight excess of titanous chloride in the presence of sodium citrate, the excess being titrated after about two minutes with a solution of iron alum either potentiometrically or using ammonium thiocyanate as an indicator. In this case the back titration is carried out in a hydrochloric acid medium. The low results due to chlorination of the nitro compound, which are sometimes obtained by the titanous chloride method of Knecht and Hibbert, are not obtained by the method described. —B.C.I.R.A.

Faulty Cotton Goods: Causes. F. Summers. *J. Text. Inst.*, 1925, **16**, T.323-337. —B.C.I.R.A.

PATENTS

Twist Tester. M. Beyaert. F.P.27,989, 1923 (from *Chimie et Industrie*, 1925, **13**, 573D).

A new form of twist tester in which the yarn is untwisted at both ends and the number of revolutions registered in the usual way. The special device for measuring the extension of the yarn on untwisting consists essentially in a pivoted beam carrying a disc and a counterpoise by means of which the yarn is kept taut. The deflection of the beam is registered on a scale. —B.C.I.R.A.

Removing Free Sulphur from Wool Grease. H. Christison and C. L. Nutting, Assre. to Arlington Mills. U.S.P.1,561,911 (from *J. Soc. Chem. Ind.*, 1926, **45**, B.26 and B.136).

Grease from raw wool is boiled with a solution of sodium sulphite, when the sulphur present forms sodium thiosulphate and is removed. The grease is then separated from the solution by centrifuging. —B.R.A.W. & W.I.

7—BUILDING AND POWER

(A)—CONSTRUCTION OF BUILDINGS

Rock Asphalte: Application. *Text. Rec.*, 1926, **43**, No. 514, 91.

Mastic rock asphalte is watertight, dustless, noiseless, wear-resisting, non-conducting, and resilient. It is therefore a highly suitable surfacing material for the floors of card rooms, bleachworks, dyehouses, &c. It is also suitable for lining tanks, &c., and a special acid-resisting preparation is made which is suitable for covering laboratory floors, &c. —B.C.I.R.A.

(B)—FIRE PREVENTION

Fire Extinguishing Apparatus. C. G. Ingall, C. J. Fox, and S. D. Willis. *Safety First*, 1926, **1**, 181-186.

A general survey of fire extinguishing apparatus and its maintenance. —B.C.I.R.A.

(C)—POWER

Geared Steam Turbine: Application. W. H. Allen, Sons & Co. *Text. Mfr.*, 1925, **51**, 421-422.

In a recent conversion of an old power plant, a double beam steam engine and a horizontal engine were removed and a geared steam turbine, which drives the spinning portion of the mill by direct rope drive to the various floors and drives the

looms by electric motors through an alternator coupled direct to the turbine, was substituted. The machinery was kept running during the change-over. Since the installation of the turbine the machines have run steadier, there are fewer end breakages and spinners are getting increased production. —B.C.I.R.A.

Lamps; Radiation from——. J. W. Ryde. *Science Abstracts*, 1925, **28B**, 457 (from *El. Rev.*, 1925, **96**, 884-886).

Data concerning the relative amounts of ultra-violet, visible and infra-red radiation emitted by various common light sources are given. The limiting wave-length, that is, the shortest wave-length of perceptible radiation is also given, and this is shown to be longer than the limiting wave-length for sunlight except in the case of certain arcs and sparks not shielded by glass. It is therefore shown that apprehension of harmful effects resulting from ultra-violet radiation from a gas-filled lamp, for example, is entirely without foundation. The filtering out of infra-red radiation is then considered, and tables are given showing for various glasses and other common substances the transmission factor for radiation of different wave lengths and the transmission for the total radiation from a black body at different temperatures. —B.C.I.R.A.

(F)—Lighting

Illumination. W. Ruffer. *Science Abstracts*, 1925, **B28**, 408 (from *Elek. u. Maschinenbau* (*Die Lichttechnik*), 1925, **2**, 53-58).

Describes the method and results of experiments to test the effect of varying illumination on acuity of vision (perception of fine filaments against a white background), power of attention, speed of vision and perception, &c. Working with illumination of from 1-600 metre-candles, it was found that in every case there was almost continuous increase of efficiency up to about 50 or 100 metre-candles. The tests performed are described in the paper. —B.C.I.R.A.

(H)—Humidification

Humidity. G. P. Paine. *Science Abstracts* (A), 1926, **29**, No. 5 (from *Proc. Nat. Acad. Sci.*, 1925, **11**, 555-562).

Energy transformation in an unobstructed air current, in an air current containing a dry obstacle, and in an air current containing an evaporating surface; with applications to an aerodynamic psychrometer and to the measurement of atmospheric humidity. An investigation was conducted into turbulent air flow and evaporation in a wind channel designed for the purpose and then extended to a psychrometer designed to admit measurement of the velocity of the air. A summary of the mathematical analysis employed and of the experimental results obtained are given. Wick characteristics were examined and a psychrometric formula developed. Under the conditions prescribed a psychrometer was constructed and compared with the chemical hygrometer. An agreement within 1·3% in the case of absolute humidity and 0·8% in the case of relative humidity were obtained. —L.I.R.A.

Patents

Moist Air: Relative Humidity. Akt.-Ges. für Anilin-Fabrikation, R. Fuchs, and H. Wolff. D.R.P.416,563 (from *Chem. Zentr.*, 1925, **ii.**, 2074).

Relative humidity in technical drying processes is measured by comparing the physical constants of the exhaust air and of a reference gas. The reference gas must be saturated with water vapour at the temperature of the exhaust air. The part of the measuring device containing water or the whole instrument is brought into the exhaust air current or is maintained by an appropriate heating device at the temperature of the exhaust air. Completion of drying is indicated by a constant maximum deflection resulting from the difference between the properties of the now dry air and the saturated reference gas. —B.C.I.R.A.

Daylight Lamp. Smith, Bulmer & Co. Ltd., and L. Stott, Halifax, Yorkshire. E.P.244,289.

In a daylight lamp the flat sides of the lamp casing and the reflectors therein are arranged at angles to concentrate the light rays from a lamp bulb upon a daylight glass panel in the front of the casing. In one form, the front part of the casing is at an angle of 67° to the horizontal and the hinged door carrying the panel is at an angle of 135° to the horizontal base of the lamp. The sides of the casing are stiffened by angular reflectors arranged at approximately 45° to the back of the chamber. The tube carrying the lamp bulb is vertically movable in a sleeve or the like secured to a slidable shutter on the top of the casing. The air inlet and exit tubes are provided with enlargements shaped like double cones and having conical-shaped baffles to prevent the escape of light. The internal sides of the casing and other parts serving as reflectors are burnished or white. The lamp may have two or more panels. —B.C.I.R.A.

8—DESIGN

Portière Curtain Fabric: Designing. —. Harleston. *Text. Mfr.*, 1926, **52**, 15-16.

A typical design for a 54 inch fabric suitable for portière curtains is discussed and directions for weaving and cutting the cards for the controlling jacquard are given. —B.C.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Waste Dyewoods: Application. E. T. Ellis. *Dyer and Calico Printer*, 1926, **55**, 52-53.

Profitable ways of exploiting waste dyewoods are discussed. The preparation of briquettes is a convenient outlet for waste barwood. Waste camwood and other exhausted wood wastes may be used for making charcoal and waste logwood is an excellent raw material for the manufacture of illuminating gas. Spent quercitron bark is a profitable source of oxalic acid and sandalwood waste is a source of alcoholic spirit. Among other uses of waste woods is the production of artificial wood and wood wool, and their use as raw materials in the gunpowder and explosives industries. Excellent sugar can be prepared from them by submitting the refuse to hydrolysis in contact with mineral acids in suitably constructed autoclaves. —B.C.I.R.A.

Artificial Silk Production in France. *Silk J.*, 1926, **2**, No. 20, 62-63.

The development in the production of artificial silk in France is not keeping pace with its increasing use in manufacture. At the present time there are 19 factories engaged in the manufacture of artificial silk and these have a total productive capacity of 37·5 tons per day. They all employ the viscose process. The Lyons district accounts for 70% of the total production but rapid progress is being made in the north and east. A list is given of the companies manufacturing artificial silk, the location of their factories and their capital and productive capacity. Of the 18 companies listed, 11 are grouped between the two syndicates La Soie Artificielle and the Société Française de la Viscose, which are also in close relationship with each other. Further, the two syndicates have combined in forming a central sales agency under the name of the Comptoir des Textiles Artificiels. This agency controls the production and distribution of raw material in France and in effect controls imports from abroad. The entire French industry is virtually, therefore, under single control. Schemes are in hand for the erection of 15 new factories. A list of the new companies is given; Courtaulds are interested in the erection of a big factory near Calais. —B.C.I.R.A.

Cotton Futures Contract. A. Bryce Muir. *Empire Cotton Growing Review*, 1925, **2**, 198-200.

A simple description of cotton futures in relation to the marketing of raw cotton is provided for the benefit of cotton growers. —B.C.I.R.A.

Cotton Consumption. J. A. Todd. *Empire Cotton Growing Review*, 1925, **2**, 246-249.

Two tables are given. The first shows the consumption of American, Indian, Egyptian, and Sundries in the United Kingdom, the Continent, U.S.A., Asia, and all other countries for 1912-13 and for each year since 1919-20. In the second table the United States' monthly consumption of Upland, Egyptian, American Egyptian, Sea Island, and other foreign cotton since August 1922-23, and the average monthly consumption each year since 1912-13 are tabulated. —B.C.I.R.A.

Cotton Production in 1923-1924 in Barbados. *Rept. Dept. Agric.*, Barbados, 1924-1925.

There were 2,687 acres under cotton, which yielded a total of 1,606,781 lb. seed cotton, or, at an average ginnery out-turn of 24·5%, 393,340 lb. lint, i.e., 146 lb. per acre, and 1,183,231 lb. of seed. Exports for the year October 1923 to September 30th, 1924, amount to 791 bales of 505·4 lb. weighing in all 409,767 lb., and valued at £37,561 or an average of 22d. a lb. The pink bollworm is now to be found in all the cotton districts of the island and preventive measures are enforced by law. The leaf blister mite and the cotton aphis did little damage during this season. Yields of over 1,000 lb. seed cotton per acre were obtained in certain districts. Extensive meteorological data are given for the whole of the island. —B.C.I.R.A.

Sisal Hemp in Ceylon. F. A. Stockdale and G. Harbord. *Bull. Imp. Inst.*, 1925, **23**, 483 (from *Trop. Agric.*, Ceylon, 1925, **65**, 106).

Experiments in the cultivation of sisal hemp are being carried on at Anuradhapura, Ceylon, where 18 acres have been planted. The plants are spaced 8 ft. by 6 ft., thus giving 908 plants per acre. The annual yield of the fibre per acre was from 0·5 to 0·6 ton. The cost of production of the fibre per ton worked out on a basis of a four years' cropping period and an annual yield of ½ ton of fibre per acre, amounted to Rs.333·69. Sisal hemp from the Experiment Station has been sold in London at £40 to £45 per ton. On the basis of an annual yield of 44 leaves per plant, an income of Rs.143·82 per acre would be obtained whilst the crop is in bearing. An area of 3-4 acres would apparently furnish a livelihood to a village cultivator and it is suggested that a trial scheme should be put forward for the consideration of the Government. —L.I.R.A.

Economics of Boll Weevil Control in U.S.A. See Section Ic.

10—MISCELLANEOUS

Portable Photometers. British Engineering Standards Association. British Standard Specification, 230 of 1925.

The pamphlet gives definitions of terms and specifications for portable photometers intended for the measurement of illumination and, in some cases, of brightness also. —B.C.I.R.A.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(C)—VEGETABLE

Boll Weevil: Control. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 635 (from *Handbook of American Cotton Association Boll Weevil Control Campaign*, Season 1924-1925, 32 pp.).

The losses sustained by the American cotton crops of 1921 and 1922 as a result of attack by boll weevil were estimated at about £200,000,000. The American Cotton Association, therefore, undertook the leadership of a general campaign, as a result of which 933 cotton demonstration farms of 10 acres were established in 1923. The growers were responsible for the success of the control measures, applied under simple and practical instructions. Many letters indicating the success of the campaign are quoted. In one of these it is stated that four good applications of calcium arsenate will result in a bale of cotton per acre on good land under heavy weevil infestation. Using poison, 1,250 lb. of seed cotton per acre was obtained as compared with 700 lb. from the same type of land without poison. It has been proved conclusively that the plan of culture and weevil control as applied under the supervision of the Association increases the yield per acre by one-third. If the work could be extended to all the infested counties the weevil would soon be definitely controlled. —B.C.I.R.A.

Boll Weevil: Effect on Yield. H. Jordan. *Rev. Appld. Entomology*, 1925, **13**, 504 (from *N. Y. Commercial*, July 7th, 1925).

The situation resulting from the gradual extension of the cotton boll weevil over the cotton crop from the south-west of Texas to Virginia during the past 30 years is reviewed, an analysis of the position in each State being given. An examination of the facts shows that no State, after infestation, has been able to regain its former yield per acre (with the possible exception of Oklahoma in 1924). Most of the States would be obliged to double their acreage in order to obtain the same productive yield as under pre-weevil conditions. Experience has shown that there is no profit to the grower unless at least half a bale of cotton per acre can be produced, and during the years 1920-1924 the cotton States showed an average yield of one bale per 3·2 acres. It is suggested that the future production of cotton must be undertaken on a restricted acreage and a highly intensive system of cultivation. The average farmer cannot successfully cultivate and handle more than 5 to 7 acres under cotton per plough under boll weevil conditions. Demonstrations of cotton growing have proved of incalculable value and well worth the outlay entailed. —B.C.I.R.A.

Pink Bollworm Control in Montserrat. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 458 (from *Imp. Dept. Agric. West Indies*, 1925, 50 pp.).

The pink bollworm was responsible for the loss of the entire second crop of cotton in many cases in Montserrat. Experiments made with close-spaced cotton, with a view to securing the maximum crop in a limited period of time in order to do away with the second crop, had somewhat contradictory results. During 1922 *P. gossypiella* was first found at the end of June, but in 1923 it was first observed about a fortnight later. The results of the examination of cotton bolls collected from fields during the two years under review clearly indicate the rapid extension of damage occurring over a comparatively short period of time. According to the Cotton Protection Ordinance of 1922, all seed should be fumigated with carbon bisulphide at the rate of 1 lb. to 120 cu. ft. of chamber space. A double fumigation did not materially reduce the germinating qualities of the seed. —B.C.I.R.A.

Cotton Bollworms in Cyprus: Life-history and Control. D. S. Wilkinson. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 322 (from *Cyprus Agric. J.*, 1925, **20**, 64-66).

Considerable damage to cotton bolls has been caused in Cyprus by *Earias insulana* and *Platyedra* (*Gelechia*) *gossypiella*. The life-histories of these moths are outlined and the measures against them ordered by the Government are described. The date on or before which growers are required to destroy all cotton, &c., is to be fixed annually and will probably be about 15th October. —B.C.I.R.A.

Cotton Pest in Barbados. C. C. Skeete. *Rev. Appld. Mycology*, 1925, **4**, 653 (from *Rept. Dept. Agric. Barbados*, 1923-1924, 8-11).

An instance is cited in which some 50% of cotton bolls were found to be diseased and failed to mature, as a result of attacks of anthracnose due to *Glomerella gossypii*. —B.C.I.R.A.

Cotton Pests in South Africa. G. C. Haines. *Rev. Appld. Entomol.*, 1925, **13**, Series A, 615 (from *J. Dept. Agric. Union S. Africa*, 1925, **11**, 361-365).

A brief review of the insect pests of cotton in South Africa. Nearly 200 insects are concerned, but the author deals only with the most important ones. The bollworms *Diparopsis castanea*, *Earias insulana*, *Heliothis* (*chloridea*) *obsoleta*, and *Pyroderces simplex* are the most serious pests. Soil drainage and local conditions appear to be factors influencing the cotton Jassid, *Empoasca* (*chlorita*) *facialis*. The only effective way to deal with soil pests attacking field crops is to maintain a close or dead

season, preferably for two months or more each winter. Boll-shedding should be thoroughly studied in connection with the study of the different pests, especially bollworms and plant bugs. The most urgent problem is to find effective and practical remedies for the bollworms. A Jassid-resistant cotton is in course of development. In the author's opinion, cotton insect control is not entirely an entomological matter but concerns agricultural practices and plant selection studies and is influenced by climatic conditions. The value of ratooning is still debatable. Serious consideration should be given to the possibility of growing other crops and of mixed farming, e.g., live stock and field crops.
—B.C.I.R.A.

Cotton Pests in Egypt, India, and Mesopotamia. B. P. Uvarov. *Rev. Appld. Entomol.*, 1925, **13**, Series A.598 (from *Cotton Industry*, Moscow, 1924, **3**, 63-77).
he insect pests of cotton occurring in Egypt, India and Mesopotamia are reviewed. The Russian cotton fields are comparatively free from any serious pests and the importance of maintaining these conditions is emphasised. —B.C.I.R.A.

Cotton Pests Control in Australia (Queensland). E. Ballard. *Rev. Appld. Entomol.*, 1925, **13**, A.557 (from *Queensland Agric. J.*, 1925, **24**, 146-147).
Trap-crops of maize are a valuable means of protecting a cotton crop from *Heliothis obsoleta* provided that they are judiciously applied. On a basis of 15 rows of cotton to the acre, two rows of maize should be planted at the same time as the cotton. This method may be modified for individual farms, but the essential point is that the maize must not be allowed to stand until the silk has dried up, or the mature larvæ will then attack the cotton. After the maize is cut, the ground is scarified to destroy the pupæ in the soil.
—B.C.I.R.A.

Cotton Seed Pests in Australia (Queensland). E. Ballard. *Rev. Appld. Entomol.*, 1925, **13**, A.557 (from *Queensland Agric. J.*, 1925, **24**, 203-206).
Tectocoris lineola, Dysdercus sidæ, and *Oxycarenus luctuosus* all feed on the seeds in open cotton bolls. The appearance of the attacked seed is described and illustrated. Of the 1923-1924 crop 30% of the seed was damaged by sucking insects.
—B.C.I.R.A.

Ceara Cotton Cultivation in Brazil. B. G. C. Ballard. *Int. Cotton Bull.*, 1926, **4**, 236-243.
A brief historical survey commences with the year 1777. The present methods of cultivation are primitive and only in Jaguaribe Valley is cotton grown as an unmixed crop. With indifferent cultivation the results are no better there than elsewhere. Yields average 190-250 lb. per acre and an increase of 50% through modern methods of cultivation and pure varieties are anticipated. The mixture sown consists of *G. hirsutum, peruvianum, purpurascens, brasiliense,* and *vitifolium*, and in consequence every bale of Ceara cotton covers a range of staple length from 15 to 40 mm. An experimental station has been established near Fortaleza, and in 1924-25, 254 selections were dealt with. Special attention is being paid to *Herbaceo*, and 6 pure Egyptian, 3 pure American, and Pima cotton have also been introduced. Mass selection from *Herbaceo* also forms part of the programme of work. It is proposed to develop seed farms in different parts of the estate. One notable correlation was observed from the observations made on 225 selected plants. The best staple both in strength and length was produced on the plants with the darkest coloured flowers. —B.C.I.R.A.

Acala Cotton Cultivation in California. *Int. Cotton Bull.*, 1926, **4**, 198.
By law enacted May 1925, the growing of any variety except Acala, in certain cotton-growing districts of the Imperial Valley, is forbidden. This variety is regarded as "the most superior and economically most profitable variety or species of cotton" for these districts. —B.C.I.R.A.

Half and Half Cotton Cultivation in U.S.A. *Int. Cotton Bull.*, 1926, **4**, 185-187.
The attention of the Secretary of Agriculture has been drawn to the notable falling off in the strength and uniformity of cotton especially in Texas, owing to the spread of such high yielding but short-stapled varieties as Half and Half. Extension of the community system is also recommended. Letters from various Co-operative Societies show that these bodies are alive to the danger, and an extract from the *Cotton News*, S. Carolina, comments on the difficulties now experienced by the growers in disposing of Half and Half cotton. —B.C.I.R.A.

Tanguis Cotton Cultivation. *Int. Cotton Bull.*, 1925, **4**, 110-113.
The seed is very small, dark brown in colour, with small and characteristic horizontal lines and a little hairy tail at the end. Its principal advantages are uniformity, ease in classification, and distinctness from every other variety. In yield it exceeds all other Peruvian types, and the smallness of the seed results in a greater ginning out-turn, namely from 40-42%. In whiteness and quality it is also superior, and the plant is wilt resistant.
—B.C.I.R A.

Cotton Cultivation in Shansi (China). *Int. Cotton Bull.*, 1925, **4**, 101-104 (from *The Chinese Economic Monthly*, Aug., 1925).
A general account of cotton growing progress in Shansi; details are given of the growers' methods. Peculiar features are,

the soaking of the seed for 24 hours in cold water and then for a few hours in slightly warm water, before mixing with wood ashes and sowing. In the middle of July the plants are topped, and a sharp look-out is kept for signs of an unnamed branch disease which necessitates ruthless pruning to prevent spreading. Bolls are gathered in October and are exposed to the sun until they burst. The varieties grown are red-stemmed and green-stemmed native types and American, notably Trice and Jinks. No indication is given of different methods for American cultivation, and it appears that the American plants are pruned and the whole bolls are picked just as the native varieties. —B.C.I.R.A.

Cotton Cultivation in Laguna (Mexico). B. F. Yost. *Int. Cotton Bull.*, 1925, **4**, 105-107 (from *U.S. Commerce Reports*).

Well irrigation supplementing the annual floodings is becoming more general. The sowing season extends from February to April, though cotton sown after March is subject to the pink boll-worm. As in Egypt this pest begins its period of greatest damage in September, and as late watering seems to assist the pest the land is seldom irrigated after 1st July. The boll weevil is also present but the extremely dry months of May, June, and July in 1925 resulted in negligible losses from this pest. Owing to the extreme dryness of the Laguna climate, and more particularly the entire absence of night dews in August and September when the cotton is ready to pick, the staple is generally shorter and weaker than that grown in the U.S.A. Long staple does not bring in sufficient premium in Mexico to compensate for the loss in yield. —B.C.I.R.A.

Half and Half Cotton Cultivation in U.S.A. A. S. Pearse. *Int. Cotton Bull.*, 1925, **4**, 9-10.

With the high parity for Indian cotton, with which it comes into competition, the "Half and Half" variety, yielding staple of only $\frac{5}{8}$ to $\frac{7}{8}$ in., has been popular in East Texas, Arkansas, Oklahoma, Georgia, Louisiana, and Alabama. Originally the ginning percentage was 48%, but through mixing of seed and lack of selection it has gone down to 42 or even 38%. Especially in East Texas the yield per acre is satisfactory and the high ginning percentage has led to its extensive growth. In the 1 in. staple districts the relatively low price this year has been an inducement for mixing Half and Half with the longer cotton. Competitions organised for the production of high yield per acre have unfortunately encouraged the growth of this variety, but for future competitions it is now stipulated that the cotton must be at least 1 inch. The Co-operative Organisation are discouraging its growth. —B.C.I.R.A.

Cotton Cultivation in Texas. *Int. Cotton Bull.*, 1925, **3**, 686-687.

Comparative tables of rainfall, temperature, weevil damage, acreage, and yield based on Government records or compiled by the New Orleans Cotton Exchange are issued by Messrs. Fenner and Beane, of New Orleans. The tables cover the seasons from 1904-05 to 1923-24, showing monthly and total rainfall during the autumn and winter; condition, weevil, rainfall, and temperature reports during the cotton season; the total cotton season rainfall and the total annual rainfall for each year; frost dates; and yield and acreage figures. The explanation of a yield varying from 98 lb. to 225 lb. per acre may be sought in these tables. —B.C.I.R.A.

Cotton Cultivation in Spain. Santiago Trias. *Int. Cotton Bull.* 1925, **3**, 630-632.

The Agricultural Cotton Association of Spain was formed to stimulate the cultivation of cotton in Andalusia. For the 1924-25 crop a minimum price of 1·10 pesetas per kilogramme of raw cotton was guaranteed to the growers. The resulting crop did not reach expectations, amounting only to 1,154 bales of 440 lb. The best results were obtained from the King variety, and this has been generally sown for the 1925-26 crop. The average of the crop is up to fully good standard American, with a staple of from 28 to 30 millimetres. In other districts experiments yielded 13 bales about equal in quality to the South Spain crop. Land at present out of cultivation for want of drainage in Alicant will have attention, and 40,000 hectares will be available. A production of 50,000 bales annually is thought possible within five years, depending, however, on the spread of an improved practice of cotton culture among the growers. —B.C.I.R.A.

Cotton Cultivation in Fiji. G. Evans. *Empire Cotton Growing Review*, 1926, **3**, 1-14.

The leeward side of the two larger islands has a definite wet season lasting from December to March, with a rainfall varying from 50-80 in. It is in this relatively dry zone that cotton is likely to do best. Yields per acre of Sea Island seed cotton averaged 232 lb. for the 270 growers in 1922-23, whilst in the following year 526 growers averaged 424 lb. per acre. Strict grading is practised and the prices for the four grades A, B, C, D in 1923-24 was 4d., 3d., 2d., and 1½d. respectively. The 1922-23 crop sold at about 2s. a lb. in the Liverpool market. Surplus after completion of sales is returned to the growers in the form of a bonus. The main objection to Sea Island is the enforced frequency of picking for the preservation of good lustre, colour, and grade. The smallness of the boll is also an objection. In consequence, a higher yielding, larger bolled species has

been sought, and from early trials the Pima strain from an area with an entirely different climate is promising. Its staple appears to run about 1⅝ in., it is of great strength and body, but slightly uneven, a little off colour, and with a texture inclined to be a little coarse and rough. A discussion is also given on local conditions, transport problems, and labour difficulties.

—B.C.I.R.A.

Oomras Cotton Cultivation in Berar (India). W. Youngman. *Empire Cotton Growing Review*, 1926, **3**, 15-23.

During the period of infiltration of short staple cotton into the better class Oomras areas, the average yield per acre has seriously diminished. The comparative lint value per acre of the better qualities also exceeds the value of the inferior Khandesh. An explanation for the wide-spread substitution of long by short qualities is not therefore to be found in these directions. It is the high ginning out-turn of the coarse varieties that is the predominant factor; and the backward cultivators also find them easier to grow. The excessive regard in which high ginning out-turn is held can be ascribed to the influence of the money lenders and the middlemen. These control the cropping to a great extent; and as weight, cleanliness, and ginning percentage are the only factors that count in the cotton sales the low out-turn of the finer quality kappas renders it unpopular.

—B.C.I R.A.

Cotton Cultivation in Tanganyika. C. N. French. *Empire Cotton Growing Review*, 1925, **2**, 299-308.

Arguments in favour of adopting the large estate farming system in the Mwanza district of Tanganyika. The system has worked excellently in the Punjab and the Gezira; and many of the disadvantages under which the Mwanza district labours cannot be overcome under the present system.

—B.C.I.R.A.

Oomras Cotton: History and Description. W. Youngman. *Empire Cotton Growing Review*, 1925, **2**, 309-316.

The short staple cotton problem in the Oomras tract of India is introduced by a historical survey containing many new points of interest and explanations of cotton nomenclature, which are not generally known. Hinganghat cotton, named after a town in the valley of the Wardha river, C.P., had once a good reputation in Liverpool. It is not improbable that this was the cotton from which Dacca muslins were made, for much of this cotton was sent down the Ganges to the Bengal weavers. The decline in the fine staple, 1-1⅛ in., cotton industry in the Oomras tract is described. *G. indicum* has now largely given way to *G. neglectum verum*, *G. n. malvense* (from Malwa, the name of the plateau in Central India), *G. n. roseum*, and *G. n. cutchicum*. The first two have yellow flowers with a red eye, and the others have white flowers with a red eye. The second and fourth have broad lobed leaves, and the first and third have narrow lobed leaves. *G. indicum* survives, however, in Hyderabad where practically the whole crop is of this variety. It is known as Gaorani (village) cotton or Moglai cotton (Moglai=Mogul, and the cotton is so called because Hyderabad is a Mohammedan State); and the North-West Hyderabad crop is sold as Barsi and Nagar (after Barsi and Ahmednagar, the railway stations from which this cotton is despatched). "Barsi and Nagar" cotton contains a mixture of the four *neglectum* sub-species, besides a large proportion of bani (*indicum*).

—B.C.I.R.A.

Cotton Seed Selection in Uganda. R. G. Harper. *Empire Cotton Growing Review*, 1926, **3**, 24-35.

An historical account of the vicissitudes experienced since 1911 in the work of improving Uganda cotton is given. N.17 is the main surviving type evolved by the author. Its general characters are described and data derived from spinning tests are included.

—B.C.I.R.A.

Cotton Pests: Control. H. A. Ballou. *Empire Cotton Growing Review*, 1925, **2**, 323-329.

Where cotton is introduced the probability of insect pest attacks must be borne in mind, and preparations made to deal with them. If a pest that cannot be controlled appears, it is better that the difficulties should be recognised as early as possible before large sums have been expended in cultivation. A knowledge of the food plants and habits of the pests is essential and the presence of an entomologist necessary. Instances are given of effective pest control and the individual importance of the pests is discussed.

—B.C.I.R.A.

Jassid-Resistant Cottons: Breeding, in South Africa. F. R. Parnell. *Empire Cotton Growing Review*, 1926, **2**, 330-336.

Jassid-resistance in cotton is an heritable quality. Preliminary work on the breeding of jassid-resistant cottons for the low velt cotton belt, which extends through the Eastern Transvaal into Zululand, is described. A jassid-resistant type raised in India, a selection from Cambodia, proved absolutely resistant; Watts' Long Staple was the most susceptible variety studied, having no resistant qualities. The Cambodia type requires acclimatisation, as in its first year in South Africa it tended to run wild. Good results were obtained with selections from a new type found in a large number of plants selected at random in Zululand, but selections from Improved Bancroft gave the most promising results.

—B.C.I.R.A.

Cotton Pollen Grains: Size Variations. H. Marsland. *Empire Cotton Growing Review*, 1925, **2**, 348-352.

Differences in pollen grain size are characteristic of different varieties of cotton. The pollen grains of Upland and Indian varieties are the smallest, those of Egyptian (Pima) and Marie Galante the largest. No correlation apparently exists between chromosome number and pollen grain size. The F_1 hybrid shows the pollen dimensions of the large pollen parent. The variation in the size of pollen from different varieties is continuous, from 108μ to 135μ. Pollen grain size is least variable in Indian with a coefficient of variability of 4·35, and most variable in the hybrid Mead by Sea Island with a C.V. of 7·64. Bourbon (probably *G. purpurescens*, or a variety of this species) is morphologically closely related to Upland and possesses pollen grains of practically the same dimensions. *G. brasiliense*, which belongs to the same group as Sea Island, also possesses pollen grains of practically the same size; the frequency curves possessing a mode of 2·3 in both cases. —B.C.I.R.A.

Cotton Pests; Incidence of, in North Rhodesia. T. C. Moore. *Empire Cotton Growing Review*, 1925, **2**, 359.

Jassid and fungoid diseases are serious in North Rhodesia. Improved Bancroft and Arizona types show more resistance and quicker recovery from attack than other varieties, and the sowing of these is advised. —B.C.I.R.A.

Cotton Production and Classification in South Africa. F. E. Sullivan. *Int. Cotton Bull.*, 1925, **3**, 627-630.

The staple and grade classification of the 1923-24 crop, together with prices received and production by districts are recorded in great detail. Full $1\frac{1}{8}$ in. and over amounted to $17\frac{1}{4}$% of the 1923 crop, compared with $24\frac{1}{2}$% the previous year. The parallel figures for $1\frac{1}{8}$ in. and good $1\frac{1}{8}$ in. were 60% and $57\frac{1}{2}$% respectively and for $1\frac{1}{16}$ in. and below, $22\frac{3}{4}$% and 18% respectively. —B.C.I.R.A.

Cotton Production in Venezuela. *Int. Cotton Bull.*, 1925, **3**, 637.

The States of Carabobo, Lara, Portuguesa, Yracuy, and Cojedes produce about 12,000 bales of 500 lb. or 54% of the Venezuelan crop. The growers say that the yield varies from about 800 to 1,600 lb. of seed cotton per acre. Sea Island and Egyptian are sown and the staple is said to be about $1\frac{1}{4}$ in. At considerable altitudes above sea level, good cotton growing soils are found in the Puerto Cabello district. —B.C.I.R.A.

Staple Cotton Production in the U.S.A. A. S. Pearse. *Int. Cotton Bull.*, 1925, **4**, 13-14.

North Texas, round Greenville and Paris, and N.W. Texas produce full $1\frac{1}{8}$ in., and Oklahoma yields a very wiry $1\frac{1}{8}$ in. cotton. Owing to the early drought, Piedmont cotton, which is usually full 1 in., will barely reach $\frac{7}{8}$ in. this year; though the grade is good. Similarly in Central Texas, where earlier reports were exaggerated, the staple is hardly likely to reach the usual full 1 in. —B.C.I.R.A.

Pima Cotton Production in the U.S.A. A. S. Pearse. *Int. Cotton Bull.*, 1925, **4**, 10.

Low staple premium led to a Pima production in Arizona of only 5,000 bales in 1924; but better prices foreshadowed, led to more extensive sowing, and this year's crop is expected to be 22,000 to 25,000 bales. The Maricopa County Farm Bureau Pure Seed Association was established in Salt River Valley for the purpose of inspecting the fields and rogueing out the short staple and hybrid plants. These are relics of the short staple crops of last year, and their removal was essential. All fields thus treated are certified and the bales are identified by a special tag, which serves as a guarantee and a safeguard to the spinners purchasing Pima cotton. —B.C.I.R.A.

Cotton Production in China during 1925. *Int. Cotton Bull.*, 1926, **4**, 244-245.

Chihli conditions are fairly good, and an increase of 30% in the crop is expected. Storms in July and August and earlier drought will be responsible for a 20% decrease in Shantung. Honan expects a 30% increase, and favourable picking weather in Shensi will show an increase of 65%. Excessive rainfall in Kiangsu has been experienced and the total decrease amounts to 260,000 bales of 400 lb. weight. Decreases in Chekiang and Hupeh of 20% and 10% respectively, and a 15% increase in Anhwei Province are also reported. The total estimate for the year represents a decrease of 3% or 80,000 bales of 400 lb. —B.C.I.R.A.

Indian Cotton: Ginning. A. S. Pearse. *Int. Cotton Bull.*, 1926, **4**, 215-217.

Spinners of hosiery yarns require a clean cotton, the feel and the length of the cotton being relatively unimportant. Seed cotton (kapas) is one of the worst forms of adulteration, because it is broken up in the opening and scutching, and the hairs adhering to each of the particles pull them through the various machines and finally they appear in the yarn. Carelessness in the smaller ginneries and labour inefficiency are probably responsible for the large amount of seed cotton frequently present in Indian bales. The introduction of saw gins for Indian cotton is not entirely satisfactory, and careful adaptation of existing machinery to the requirements of extra short staple is required. —B.C.I.R.A.

Cotton Pests in Australia: 1924-25 Report. E. Ballard. *Empire Cotton Growing Review*, 1925, **2**, 341-347.

Fungus diseases and boll rots are prevalent especially in the coastal cotton; and the

Pentatomid bug, *Tectacoris banksii* (locally known as the Harlequin or Chinese bug) is thought more responsible for infection than Dysdercus. Experiments support this contention; and control by hand picking is found effective. Dysdercus control has not been satisfactorily solved. *Heliothis* (*Chloridea*) *obsoleta* is susceptible to control by trap cropping with maize; and maize at the tasseling stage also attracts the Peach Moth (*Dichocrocis punctiferalis*). Another pest, *Eucosma plebiana* damages the terminals, squares, and the young bolls, and the greatest severity of attack occurred during the first ten weeks' growth. This pest was serious after December in only one area where the soil was markedly deficient in potash and phosphate. Many field observations have led to the conclusion that there is an intimate connection between soils deficient in these constituents and insect attacks on cotton by certain species. Pink bollworm larvæ were swarming on the ratoon and standover cotton coming into the ginneries from the central districts during April. In the Mount Larcom district and a district between Rockhampton and Emerald the jassid or leaf hopper is also prevalent. This pest is also thought to be associated with soil deficiencies. —B.C.I.R.A.

Egyptian Cotton: Crop Reports 1924-25; 1925-26. J. G. Joannides & Co. *Int. Cotton Bull.*, 1925, **4**, 82-89.

Extracts are given from a pamphlet issued by J. G. Joannides & Co., Alexandria, which deals with acreage, quantities of each variety yield per acre, quality of each variety, market prices, and the distribution of the Egyptian crop. The Government figure of 1,787,843 feddans for the 1924-25 acreage is disputed by the trade; 1,950,000 feddans is considered a closer estimate. On this basis the average yield per feddan was 3·62 cantars, compared with 3·65 cantars in the previous year. Middle and Upper Egypt averaged 4·42 as compared with 5·00 cantars in 1923, and the Lower Egyptian yield increased from 3·18 cantars to 3·313 cantars. Excessive temperatures in August and September were responsible for the Upper Egyptian decline in yield; and this was also the reason for a certain amount of immature cotton, grade depreciation owing to leafiness, and reduction in staple length. The exceptional success of the Sakel crop and the larger acreage of the heavier yielding Zagora and Pilion resulted in increased average yield for the Delta. In respect of quality there was much complaint of Sakel adulteration with Zagora and Pilion. The Delta Zagora is browner, softer, and rather wastier than Uppers Zagora and sold about 3% cheaper throughout the season. Pilion prices exceeded Uppers from about 5% to 10%. It was found to make a good substitute for medium grade Sakel, and as it was relatively cheap it was in good demand. Brown cotton was only required by concerns manufacturing specialities and very little interest was shown in the white cotton. The Government 1925 acreage estimate is considered about 125,000 feddans short; and it is privately estimated that 1,200,000 feddans are under Sakel, 700,000 feddans under Zagora and Ashmouni, and 150,000 feddans under Pilion and other varieties. On this acreage basis a forecast of the present crop is given as follows—

	Bales	lb. per bale	Cantars per acre
Sakel	480,000	710	2·84
Ashmouni & Zagora	465,000	705	4·68
Pilion & others ...	80,000	705	3·70

From this estimate, the carry over, and the growth of similar staples throughout the world it is considered that there will be an ample supply of medium staples for world requirements. But only a 4% increase in Sakel quantity is indicated and prices should remain moderate. Tables are given showing the export of cotton from Alexandria to various countries, and the arrivals of ginned cotton in Alexandria, month by month, from August 1924 to July 1925. —B.C.I.R.A.

Cotton Plant Diseases in the United States. W. Robinson. *J. Text. Inst.*, 1926, **17**, P13-14.

(D)—Artificial

Cellulose-Decomposing Bacillus: Description. J. A. Viljoen, E. B. Fred, and W. H. Peterson. *J. Agric. Sci.*, 1926, **16**, 1-17.

A thermophilic organism which destroys cellulose at 65° C. has been isolated in pure culture. The organism is motile, gram negative, forms spores in the swollen end, stains well with carbol fuchsin and poorly with methylene blue. After growth on media without cellulose it is unable to ferment cellulose. The range of fermentation is from 43° C. to 65° C. The organism lives at 38° C. and 72° C., but does not ferment at these temperatures. The spores survive heating at 115° C. for 35 mins., whilst heating at 100° C. for 5 to 10 mins. causes increased rate of germination. Starch and a number of sugars are also fermented by the organism. Organic nitrogen is necessary and peptone is the best source. Cellulose yields acetic acid, small amounts of butyric acid, ethyl alcohol, carbon dioxide, and hydrogen. The amount of cellulose destroyed in a 1-5% suspension varies from 70-95% of which 50-55% is recovered as acetic acid, 5·25% as ethyl alcohol and the rest as small amounts of butyric acid, carbon dioxide, hydrogen and pigment. The fermentation begins 12 to 18 hours after inoculation, and is soon stopped due to accumulation of acid. This can be prevented by adding excess calcium carbonate to the medium. —B.C.I.R.A.

Celanese Properties: C. W. Palmer. *Text. Merc.*, 1926, **74**, 262.

Some properties of Celanese are discussed; the material is said to withstand perspiration, some browning occurring after long wear, and to be resistant to salt water. —B.C.I.R.A.

Artificial Wool Production in Germany. *Silk J.*, 1926, **2**, No. 22, 49.

At least three German concerns are producing "artificial wool." The Glanzstoff Fabrik in particular has produced a new yarn known as the "VL yarn," the strength, elasticity, and "handle" of which compare favourably with those of natural wool, whilst its lustre is like that of real silk. Only limited experiments have been made in the form of fabrics, but a woven fabric is said to have shown certain novel features not hitherto associated with a cellulose product. Mention is made of the development of "Vistra" and of the reported experiments of the Spinnstoff-Fabrik, Zehlendorf on the production of artificial wool by an acetate process. —B.C.I.R.A.

Snia-Fil: Application. Snia Viscosa Co. *Silk J.*, 1926, **2**, No. 21, 62.

Claims that the wool-like artificial fibre snia-fil is well adapted for use in woollen manufacture since carding, combing and spinning methods are identical with those of wool. It is advisable to oil the sliver before combing with the following mixture —Rape seed oil, 30 per cent.; arachis oil, 50 per cent.; and petroleum, 20 per cent. The proportion used is 1½ per cent. of the weight of the top. —B.C.I.R.A.

Patents

Process of Producing Cellulose Acetate. V. B. Sease and E. I. du Pont de Nemours. U.S.P. 1,546,679 (from *Text. Colorist*).

The vapours of acetic acid and acetic anhydride are brought into contact with cellulose until 100 parts have absorbed from 30 to 250 parts of each gas. —F.G.P.

Formed Viscose. J. Huber, P. Eckert, and A. G. für Anilin Fabrik. U.S.P. 1,550,360.

A process of manufacture in which an alkaline silicate is added to the lye in which the xanthate is to be dissolved. —F.G.P.

Manufacture of Fine Viscose Silk. J. Huber and P. Eckert, and A.-G. für Anilin Fabrik. U.S.P. 1,550,361 (from *Text. Colorist*).

A particularly soft feel and a high degree of toughness, tensile strength, and elasticity are claimed by adding to the xanthate solution lye an emulsoid capable of modifying the viscose. —F.G.P.

Purification of Viscose Solutions. W. J. Stevenson and Artsilk, Ltd. U.S.P. 1,556,174 (from *Text. Colorist*).

The solution, prior to its formation into filaments in the precipitating bath, is submitted to a centrifugal separating treatment and then pressed through a filter containing powdered charcoal. —F.G.P.

Process of Treating Cellulose Acetate. E. S. Farrow and Eastman Kodak Co. U.S.P. 1,557,147. (from *Text. Colorist*).

A reaction mass of chloroform-soluble cellulose acetate, having a large surface relative to its mass and from which part of the acetic values have been removed in a solution of ortho phosphoric acid (over 60%), is dissolved and the solution maintained until an acetone-soluble acetate is produced, which is precipitated and washed. —F.G.P.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(B)—Spinning and Doubling

Mule Frame: Control. R. Fletcher. *Text. Mfr.*, 1926, **52**, 47-48.

A general discussion of the relation between copping and winding on the mule. —B.C.I.R.A.

A New Self-doffing Flyer Spinning Frame for Worsted. *Text. Mfr.*, 1926, **52**, 53.

J. T. Boyd, Ltd., Shettleston Ironworks, Glasgow, are introducing a mechanical doffing flyer spinning frame that is capable of spinning at a speed of 5,000 r.p.m. A general view of the frame is shown in Fig. 1 with its 24 spindles, and Fig. 2 shows a new set of empty bobbins, just moved into spinning position. The doffing is accomplished by a plate wheel, which turns the lifting rails through 180°, and the operation occupies 30 seconds. The cutting device has been made with cutting edges that are easily kept sharp and so placed as to cut the yarn close to the bobbin, and the threads are automatically carried into the path of the cutter. A patent centrifugal drag device is embodied that operates satisfactorily at all spindle speeds. —B.R.A.W. & W.I.

Mule Yarn Easing Motion: Description. Textile Accessories, Ltd. *Text. Merc.*, 1926, **74**, 151.

The device "cushions" the action of the faller weights upon the tension of the yarn during backing-off and on the commencement of winding. It is claimed that with the device it is possible to use extra faller weights, 50% for 30's counts and 30% for 40's without damage to the yarn. The size of the builder wheel can be increased so that a greater length of yarn for a given count can be wound on the same size of cop. A better built, harder and firmer cop is obtained. —B.C.I.R.A.

Artificial Silk Twisting Machine. *Silk J.*, 1926, **2**, No. 21, 44-45; No. 22, 47.

A general description of a typical twisting machine for producing fancy twist yarns of artificial silk. Formulæ for use on this machine are given. —B.C.I.R.A.

(D)—Yarns and Cords

Tyre Yarn: Spinning. A. S. Pearse. *International Cotton Bulletin*, 1925, **4**, 13-14.

In balloon tyre manufacture, some makers are still using the best Sakel, especially where only a few plies are employed; but where six plies are used, the long Sakel staple is thought unnecessary, and $1\frac{3}{16}$ American has already taken its place to a large extent. General adoption of the latter class is expected. The balloon tyre, in contrast with the ordinary cord, requires more plies of wider cloth, and is likely to have a decided effect on the consumption of staple cotton. A good supply of the staple cotton is expected this year, for besides the increase of 100,000 bales in the Delta alone, reports from other staple producing districts are favourable. —B.C.I.R.A.

Hosiery Yarns: Properties. J. Chamberlain. *Text. Rec.*, 1926, **43**, No. 515, 79-82 and 88.

The requirements of the ideal knitting yarn are discussed. Cotton yarns used in the hosiery trade include condenser yarns used for cheap hosiery and the backing yarn of fleecy fabrics, ordinary cotton hosiery yarns, lisle thread yarns which are harder twisted than ordinary cottons, mercerised yarns, sewing threads for making-up, and cotton yarn mixtures. All forms of artificial silk yarns are used in the knitting industry, and hosiery yarns are now being used containing artificial silk with cotton and worsted to produce three-colour effects. The counts of cotton yarn which can be worked on knitting machines of various gauge is given for plain knitting as follows—For full-fashioned bearded needle machines cotton count=(Needles per inch) 2/30, and for latch needle circular machines count=(Needles per inch) 2/18. Rib and fancy knitting requires relatively finer counts. Cotton yarns in use in the hosiery trade and the marketing of hosiery yarns are discussed. —B.C.I.R.A.

Dress Fabric Cotton Yarns: Application. S. B. L. Jacks. *Text. Merc.*, 1926, **74**, 257.

The chief causes of complaint *re* cotton yarns for the Bradford trade, are fluff, neppy cotton, and dirty piecings. The importance to the Bradford trade of producing knotless yarns by splicing ends together is emphasised. —B.C.I.R.A.

Cotton Yarns: Moisture Relations. A. R. Urquhart and the late A. M. Williams. *J. Text. Inst.*, 1926, **17**, T38-45.

Patents

Treatment for Reeds and Canes. L. von Ordody et Société Bettha Schottik and Co. F.P.587,499.

The lye used for this treatment is an emulsion of soap and petroleum obtained by boiling one part in weight of ordinary soap with three parts of petroleum until a compact and transparent mass is formed, the emulsion of which is obtained by digesting one part in 20 to 50 parts of water. An alkali caustic (potash, soda, or ammoniac) is added to this emulsion in such quantity that the lye be 1° Bé. This lye is poured on reeds or canes, previously retted, for three hours under pressure. The materials are afterwards rinsed, acidulated, washed, and dried; fine fibres are thus obtained. —Bur. Text.

New Spinning Device. G. Lecomte. F.P. 588,792.

In this device none of the ends of yarn are turned between the delivery roller or bobbin and the spindle which are stationary, but the portion of yarn included between these two ends is turned by means of guiding and revolving organs which turn and constitute the means of twisting. —Bur. Text.

Feed Apparatus for Winding Frames. Stermann et D'Hondt. F.P.589,008.

The yarn is conducted in the proportions needed to winding frames without any tension. Guides conduct the yarn along feeding rollers of conical form, and it is carried away by means of a disc with an helicoidal groove in which runs a projecting wire point bound to the yarn-guide. This apparatus applied to balling machines makes regular and equally weighted balls. —Bur. Text.

Roller Drawing Head. A. C. Butler, Deansgate, Manchester. E.P.245,043.

A roller head for drawing fibrous materials comprises rollers arranged so that the back and middle bottom rollers are positioned apart beyond the length of the longest fibres, the lower intermediate roller projecting between converging parts of the front rollers and the fibre being drawn over a further roller under the pressing action of a plate. —B.C.I.R.A.

Card Clothing. E. Graf, Rapperswil, Switzerland. E.P.245,142.

Card clothing for the flats of finisher cotton carding-engines is provided with staple teeth a portion of which, from the crown to the bend, is embedded in the foundation. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Preparatory Processes—

245,078. A.-G. für Anilin-Fabrikation, Decolorising process for acetylcellulose and similar derivatives.

Spinning—

244,821. W. W. Groves and Duplex Yarn Co. Device for simultaneously spinning rovings of long and short fibres.

244,985. E. Pensotti. Rotary pump for artificial silk: movable abutment type.

245,024. W. Prince-Smith and D. Waterhouse. Thread-guide spring.

3—CONVERSION OF YARNS INTO FABRICS

(B)—Sizing

Artificial Silk: Sizing. W. B. Crompton. *Silk J.*, 1926, **2**, No. 22, 54.

The characteristic properties of artificial silk yarns are discussed in relation to sizing, and a typical specially designed machine for sizing artificial silk warps is described. —B.C.I.R.A.

Wheat Flour Gluten: Quality Test. J. S. Remington. *Industrial Chemist*, 1926, **2**, 35-38.

Some factors affecting the strength of wheat and flour are discussed. Results so far obtained seem to indicate that climate is the chief factor in producing changes in the chemical composition of wheat, and in influencing gluten formation in the wheat grain. Methods devised in the author's laboratory for determining gluten quality are described. —B.C.I.R.A.

Mildew: Control. G. Smith. *Text. Mfr.*, 1926, **52**, 40-42.

The relation of sizing to the mildew problem is discussed, and it is stated that the present system of regarding mildew as a sizing problem is not necessarily correct or just. Some moulds known to occur on cloth are described. —B.C.I.R.A.

(C)—Weaving

Multiple-leaf Tappet. T. A. Brandwood. *Text. Mfr.*, 1926, **52**, 50-51.

General observations on multiple-leaf tappets; a typical example is given. —B.C.I.R.A.

Warp Tension Motion. W. Gledhill. *Text. Merc.*, 1926, **74**, 249.

The standard type of warp beam is used and round the collars a chain is passed. One end of each chain is fixed to an eccentric rod mounted in the ends of two levers each pivoted on a stud fixed to a movable bracket secured at the bottom front of the end framings. The normal position of the eccentric rod is down, but by operating a hand lever secured to one end of the rod it is turned over into the top position and the tension so taken off the two chains. Above the lever and operating against a bracket fixed to the back of the loom frame is a spiral spring which is compressed when the eccentric rod is in the normal position. The other ends of the chains are secured to the extremities of two side levers carrying a vibrating warp rail. The levers are pivoted on studs secured to the insides of the end frames. Through the other ends of these levers are passed thin rods hooked at their bottom ends to the middle of the bottom levers. On the top of each rod is placed a spiral spring resting on the upper levers. By means of nuts, greater or less compression can be put on the springs. This gives a uniform tension to the warp; the vibrating rail gives uniform easing and reduces the shock to the warp to a minimum. —B.C.I.R.A.

Reed Drawing-in Mechanism. Messrs. Fredholm and Fleischler. *Text. Merc.*, 1926, **74**, 248.

A small frame carrying the apparatus is mounted under the reed, the swinging reed hook passing upwards between the dents. A fibre brush maintains the warp ends in position and so assists the drawer. The shaft on which the reed hook is secured is caused to turn by a strap at one end and a spiral spring at the other. To the strap is secured a stirrup which, when depressed by the drawer's foot rotates the hook backwards. During the backward action the selector on the hook causes the hook to move into the next dent. The drawer places the required number of ends under the hook, and by lifting her foot allows the hook to revolve forward, so carrying the ends through the reed. When the hook has traversed the length of the bar, the frame is moved further along the reed by loosening the winged nut, the hook meanwhile remaining in the reed ready for the drawing operation to be continued. —B.C.I.R.A.

Artificial Silk Loom. Wilson and Longbottom, Ltd. *Silk J.*, 1926, **2**, No. 22, 65.

The loom is suitable for weaving crepe-de-chine and charmeuse but may be adapted with suitable yarn beams for linen, cotton or worsted warps. It has a specially designed take-up motion; increase in the diameter of the cloth roller automatically adjusts the take-up. The warp beam arrangement, which is independent of the loom and is placed immediately behind, is of very strong construction to prevent vibration. The let-off motion is friction controlled. It is impossible for a broken thread to become entangled with any part of the loom mechanism. The loom is made for two, three, or four shuttles, and has a special shuttle-catching mechanism. The stop-rod lifting device and swell easing motion ensure perfect picking, reduce wear and tear to a minimum, and enable the loom to be readily reversed when required. There is a centre weft fork capable of adjustment outside the loom without disturbing the warp. A fluted roller spreading motion assists the temples in maintaining the piece perfectly straight.

The looms are individually motor driven, the motor being incorporated in the design of the machine. Tests show that looms with up to 70 in. reed space can be run very satisfactorily with $\frac{3}{4}$-h.p. motors. —B.C.I.R.A.

(D)—Knitting

Knitted Gloves: Manufacture. W. Davis. *Text. Rec.*, 1926, **43**, No. 515, 75.

A short general account of the methods of producing gloves on knitting machines. —B.C.I.R.A.

Seaming Systems for Knitted Fabrics. W. Davis. *Wool Record*, 1926, **29**, 593.

In knitted fabrics the overlock seam is used extensively. This tends to stand up at right angles and so to cause discomfort. In the case of underwear and with outer garments it tends to open when strain is applied. To overcome these disadvantages the overlock seam is tightened along one thread of the seam (Fig. 3), and a chain seam is added which flattens the ridge (Fig. 4) which is then well pressed. In the flat stitch type of seam, the whole method of joining is changed; the two edges of the cut fabric are pressed into the machine together and a new piece of fabric structure is inserted into the join. Where the fabrics touch there is a double crossing of threads. This seam requires a considerable amount of thread and sewing material and is not sufficiently elastic for certain classes of goods, which defect may be minimised by allowing a greater or less quantity of thread to pass into the fabric. The writer has carried out experiments which show that for the plain chain stitch the take-up is from $3\frac{1}{2}$ to 4 yards of seaming thread for every yard of seam made and ordinary lockstitch required from 22 to 28 yards of sewing cotton per yard of seam. For the overlock seam the take-up may vary between 12 and 14 for average styles of stitch. A three-thread overlock seam used largely for outer garments has been evolved, and examples have been observed where this join has used less thread than the two-thread seam. In the flat lock seam the combined take-up is 35 yards for one yard of seaming. The double-locked chain stitch with the strength of the lockstitch (Fig. 5) gives a view of the overedge principle of chain-stitch where the stitch is made to go over the edge of the fabric in seaming. —B.R.A.W. & W.I.

Artificial Silk Warp Loom Fabrics. W. Davis. *Silk J.*, 1926, **2**, No. 22, 45-46.

A general explanation of the construction and method of production of warp loom fabrics. The threads of the warp which are arranged on a beam similar to a weaving beam are knitted on each other by a sideways movement of guide bars. Warp loom fabrics have a desirable stretch in width and very little yield in length. Owing to the placing of the warp threads, vertical colour schemes are easily introduced. Cut edges do not curl as do the edges of an ordinary knitted fabric which is cut. —B.C.I.R.A.

(F)—Subsequent Processes

Doubling and Folding Machine. *Silk J.*, 1926, **2**, No. 21, 52.

An improved modification of the original Monfort machine for doubling very fine fabrics is described. The distinguishing feature is the reduction of the swinging masses to a minimum, thus greatly increasing the productive capacity of the machine. The folding blades are mounted in a carriage which is moved by steel roller chains, and they can be adjusted quickly and accurately to the desired length of fold. The fold holders are clamped to bright rods actuated by levers operated by double cams. The production of the machine is 44 yds. to 77 yds. per minute. —B.C.I.R.A.

Patents

High-speed Loom. Fili Schwarzenbach and Co. F.P.588,209.

In this loom the pick and the reed are independent. At the moment of the stroke the reed is separated from the pick and pulls out at a greater speed and further up to the point of the stroke. The reed, with its shuttle guide, is articulated with the pick under the linking point of the driving crank arm, and is driven by means of a cam. —Bur. Text.

Improved Warp Protector. M. Waigel. F.P.588,852.

The brake has two shoes mounted on a common pivot. The exterior shoe passes over the interior and both are maintained quiet with springs, so as to act against the arrival of the shuttle; firstly, the interior shoe is pressed by both the springs, and afterwards each shoe by its distinct spring gives a complete break. —Bur. Text.

Multi-feed Rib Frame Patterning Mechanism. Lord Hollenden, G. H., C. H., and C. Morley, London, and L. Mayfield, Woodthorpe, Nottingham. E.P.244,809.

Interlocked fabrics and ornamental effects such as vertical stripes, are produced by the use of needles with supplementary butts situated above the knitting butts. The invention is described in connection with a multi-feed rib machine. Some or all of the cylinder needles are provided with butts which may be arranged alternately when interlocked rib fabrics are to be made. Rib needles with long butts may be arranged alternately with needles having long tails and short butts. The needles with corresponding butts work together at each feed. This is done by forming the rib needle clearing cam at alternate feeds with a deep passage through which all the butts can pass, and by providing a cam

which acts on the long tails to move the short butts beyond the point of the clearing cam. At the remaining feeds, the corresponding passage below the clearing cam is only deep enough to take the short butts. The supplementary butts differ in length and in position along the needle stems. —B.C.I.R.A.

Circular Knitting Machine Patterning Mechanism. A. Kirkland, Walnut St., Leicester. E.P.244,887.

Rotary patterning or selecting devices mounted on axes inclined to the needles are combined with jacquard or like means for moving needle-operating members carried by the pattern wheels out of operative position. Means of storing or carrying the portion of the perforated or jacquard strip or band not immediately in use are described. —B.C.I.R.A.

Shuttle-checking Mechanism. J. E. Grosvenor, Bagley, and W. T. Picking, Kidderminster. E.P.244,905.

In order to arrest the incoming shuttle in a definite position before it reaches the outer end of the shuttle box to allow the shuttle boxes to move, an inclined surface of an adjustable plate fixed to the framework is adapted to be engaged by a runner on a plate hinged to the lay. A buffer on the plate is thus moved to engage the picking-stick and move the picker to meet the incoming shuttle. When the lay moves forward to beat up the weft, the runner moves down the inclined surface and allows the picking-stick to move outwards under the influence of the usual spring. The provisional specification describes also an arrangement in which the picking-stick engages the inclined surface directly, without the intervention of the hinged plate. —B.C.I.R.A.

Shuttle-checking Mechanism. H. Boothroyd, Honley, near Huddersfield. E.P. 244,940.

Levers mounted on the breast-beam of a loom are connected by straps passing round pulleys on the lay to the picking sticks, and are alternately held by latches so that the picker towards which the shuttle is travelling is advanced to check the shuttle. A lever rocked from the usual picking rod carries lugs which raise the latches alternately. Fingers on the usual stop-rod raise both the latches when the loom is stopped. Lugs on the lay return the free lever into engagement with its latch on the forward movement of the lay. Projections on the levers limit their backward movement. —B.C.I.R.A.

Artificial Silk Sizing Mixture: Preparation. British Celanese, Ltd., London, and C. F. Ryley and G. A. Awcock, Spondon. E.P.244,947 and 244,979.

Sizing preparations for yarns and threads, particularly those of silk, spun silk, or artificial silk, comprise one or more water-insoluble salts or soaps of resin acids or of naphthenic acids in combination with one or more lubricating agents, namely, non-volatile non-drying oils, fats, waxes, or liquid or solid fatty acids. The water-insoluble resin or naphthenic acid salts or soaps are preferably those of calcium, magnesium, zinc, aluminium, or equivalent metals. One or more soaps of fatty acids, including those of sodium, potassium, ammonium, but preferably those of calcium, magnesium, zinc, or aluminium, may be added. The resin or naphthenic acid soap or salt may be dissolved in benzole, toluole, xylole, oil of turpentine, &c., with admixture of the lubricating agent. Alternatively, emulsifying agents may be used or the materials may be melted together. The metallic bases in the preparations reduce the tendency to electrification during the working of the yarns. The size may be removed by scouring with a soap solution with or without previous treatment with acid. Similar preparations comprise one or more lubricating agents together with one or more resins, as dammar resin or gum mastic and one or more soaps of fatty acids may be added. —B.C.I.R.A

Warp Knitting Machine Tuck Stitch Mechanism. G. Beardsley & Co. Ltd. and G. A. R. Beardsley, Ilkeston, Derbyshire. E.P.244,970.

In a Milanese knitting machine, a predetermined and selected number of needles are pressed at each course to produce tuck stitches. The threads from oppositely moving bobbins are crossed and held by the usual shogging and laterally fixed bars, and are fed to the needles by the picking-up bar; the presser-bar then closes the needle beards and the sinkers remove the old loops. The presser-bar is notched at intervals so as to accommodate one or more needles which are therefore not pressed, and the bar is shogged through a link-and-lever system from an intermittently rotating cam. A modification is also described. —B.C.I.R.A.

4—CHEMICAL AND OTHER PROCESSES

(G)—BLEACHING

Straw Bleaching and Dyeing: Modern Methods. C. Williams. *Dyer and Calico Printer*, 1926, **55**, 150-151.

Discussion of the dyestuffs used for cellulose acetate products. —A.J.H.

Bleaching Damage; Methods for Recognising——. *Text. Rec.*, 1926, **43**, No. 517, 65 (from *Leipziger Monats.*).

A description of practical methods for detecting iron, copper, lead, calcium, kier, mineral oil, oxycellulose, and hydrocellulose stains in bleached fabrics. —A.J.H.

Water Softening. See Section 10.

(H)—Mercerising

Mercerised Cloth: Tension and Lustre. H. P. Curtis. *Text. Merc.*, 1925, **74**, 159.

In a lecture on some common faults in finishing it is stated that piece-goods, when mercerised, have not the lustre shown in cloth woven from mercerised yarns, and this effect is ascribed to the unequal tension of the warp and weft during the mercerising process. The warp of the piece, which is under less tension than the weft, shows less lustre than the weft. The shrinkage of cloth mercerised without tension increases the fullness and strength of the cloth, and it is suggested that there is a trade for this kind of fabric, for example 42 in. to sell as 30/31 in. finished. The lustre would not be great but the cloth might be more saleable in foreign markets because of its increased affinity for colour. —B.C.I.R.A.

(I)—Dyeing

Artificial Silk Dyeing Machines. R. Sansone. *Silk J.*, 1926, **2**, No. 20, 59 and No. 21, 50.

The types of plants in use for dyeing artificial silk are indicated. In the Zittauer type described the silk is carried on copper-plated iron rods connected in pairs rectangularly. These rest in semi-circular holes along the sides of the large dye vat. A carriage running backwards and forwards on overhead rails along the length of the vat is so designed that, in passing, each rectangle formed by the rods is turned over. On the return of the carriage the rods are rocked back into their original positions. By this motion the hanks oscillate laterally. The plant is employed for wetting out, dyeing, and rinsing. —B.C.I.R.A.

Vat Dyes on Wool. C. A. Seibert. *Text. Rec.*, 1926, **43**, No. 517, 63-71.

A description of the methods of application to wool of thirteen soluble vat dyestuffs marketed by the General Dyestuffs Corporation, the dye liquors employed containing ammonia, glue, and hydrosulphite but no caustic soda. —A.J.H.

Colour Mixtures: Geometrical Calculation. J. Guild. *Sci. Abstr.*, 1926, **29B**, 19 (from *Trans. Optical Soc.*, 1924-1925, **26**, 139-174).

Starting from the experimental fact that any colour can be uniquely expressed by a trichromatic equation, provided negative coefficients may enter, it is shown that all problems of colour mixture are amenable to an exact system of geometrical calculation. The methods given obviate the introduction of stereographic projection and other geometrical complications. This simplification is effected by conducting the actual colour mixture part of any calculation in the quantity units of one trichromatic system, leaving the relative magnitudes of the various systems of units, where more than one system is involved, to be accounted for by suitable coefficients in the arithmetical part of the work. A number of worked examples illustrate the methods. —B.C.I.R.A.

Dyeing Textile Fibres with Native Shrubs and Herbs. A. R. Norwood. *Dyer and Calico Printer*, 1926, **55**, 174-175.

The colouring matters present in such plants as clover, dandelions, docks, bryony berries, whortleberries, wood, alkanet, St. John's wort, weld, and heather, are discussed and methods for applying them to cotton and wool are described.—A.J.H.

Fixation of Chrome Mordants and Colours on Cotton. H. R. Band. *Dyer and Calico Printer*, 1926, **55**, 170-171.

Experimental results obtained in dyeing cotton with Mineral Khaki and in mordanting cotton with chromium bisulphite, acetate, and formate. —A.J.H.

Dyeing Cotton Artificial Silk Piece Goods. H. Blackshaw. *Dyer and Calico Printer*, 1926, **55**, 166-167.

Description of dyeing processes, continued attention being drawn to methods of dyeing viscose silk materials likely to show "bar" effects with direct, basic, sulphur, and vat dyestuffs. —A.J.H.

Theories of Dyeing. S. H. Jenkins. *Dyer and Calico Printer*, 1926, **55**, 152-153.

Review of the chemical, mechanical, colloidal, and electrical theories of dyeing. —A.J.H.

Dyeing Artificial Silk. E. Greenhalgh. *Dyer and Calico Printer*, 1926, **55**, 146-147.

Discussion of the absorption of dyestuffs by cellulose acetate silk in relation to phototrophy and by various artificial silk knitted goods in relation to the avoidance of "veined" effects, which are due to uneven wetting-out before dyeing. These may be avoided by scouring the silk at 75°-85° C. before dyeing. —A.J.H.

Modern Methods of Dyeing Straw. See Section 4G.

(L)—Waterproofing

Rubber: Manufacture, and Properties. H. P. Stevens and B. D. Porritt. *Rubber and Engineering*; pamphlet, 32 pp.; 1925. (Supplied free on application to the Rubber Growers' Association, Inc., 2-4 Idol Lane, Eastcheap, London, E.C.3.)

This booklet explains the preparation and properties of rubber. The only connection between textiles and rubber discussed is waterproof cloth manufacture, but facts are mentioned which may have their interest in textile engineering. For example, rubber is more lasting than steel

under abrasion. The notes on storage should also be useful. Generally speaking, rubber should be stored in a cold humid room, protected from bright light. Contact with copper or its alloys or compounds, or with turpentine must be avoided, and sharp folds or local tensions should be prevented. Rubber goods can be made to meet special requirements. For example, balloon rubber which does not deteriorate in tropical sunlight, and printer's "offset" blankets which will stand continual contact with oily ink. Balloon rubber is useless for printers' purposes, and it appears that those who desire to use rubber should state their exact requirements. —B.C.I.R.A.

Waterproofing Artificial Silk Hosiery and Knitted Goods. *Text. Rec.*, 1926, **43**, No. 517, 78.

Reference is made to a secret process by which artificial silk knitted goods may be rendered impervious to water without affecting lustre or dyed colour. The effect is fast to soaping. —A.J.H.

Patents

Weighting, Mordanting, and Waterproofing Animal and Vegetable Materials. J. Sonnery. F.P.594,524 (from *J. Soc. Chem. Ind.*, 1926, **45**, B189).

The textile material is impregnated with barium aluminate solution. The aluminate is then decomposed *in situ* by treatment with CO_2, or with solutions of alkali or ammonium carbonates, phosphates, or silicates. Alternatively, impregnation with a solution containing, e.g., ammonium carbonate may precede treatment with barium aluminate. Repeat the process until the material is weighted as desired. —B.R.A.W. & W.I.

Dyeing or Colouring of Products made with Cellulose Acetate. G. H. Ellis and American Cellulose Co. Ltd. U.S.P. 1,545,819 (from *Text. Colorist*).

Colouring materials known as indophenols, in a reduced state, are applied to the fabric in a process described. —F.G.P.

Process of Dyeing Cellulose Acetates. R. Clavel. U.S.P.1,546,969 (from *Text. Colorist*).

Vat dyes are used in a hydrosulphite bath with just sufficient ammonia to form the leuco compound. The bath should also contain a protective colloid and at least one water soluble salt. —F.G.P.

Process of Dyeing Cellulose Acetates. R. Clavel. U.S.P.1,549,906 (from *Text. Colorist*).

Developing dyes are used in the process; both the base and developer are applied in the presence of a soluble chloride and a protective colloid. —F.G.P.

Bleached and Dyed Furs. H. Stein, W. E. Austin, and J. Lieböwitz (Assrs. to Stein Fur Dyeing Co.). U.S.P.1,564,378 (from *J. Soc. Chem. Ind.*, 1926, **45**, B189).

Clean fur is immersed in a solution of ferrous sulphate containing ammonium chloride, and then bleached by treatment with hydrogen peroxide. The ferrous sulphate protects the skin against any harmful oxidation. —B.R.A.W. & W.I.

Skein Mercerising Machine. C., G., and F. Bonnet, Villefranche-sur-Saône, France. E.P.244,806.

In a machine for mercerising skeins of yarn of the type in which the tension between two rollers, one movable and one fixed, is controlled by a cam and system of counter-weighted levers; the levers are arranged in triangular formation, one side of the triangle comprising two levers pivoted on the same axis, whilst the apex of the triangle is acted upon by a cam. This arrangement minimises the pressure on this cam. A counterweight acts on the pivot and two levers are connected by a link to a movable roller. The tension on the skeins can be varied at any time by adjusting the position of the counterweight. A cam-operated drying roller is carried by a rocking arm pivoted to the frame of the machine. The roller is carried by a frame which is pivoted at its middle, so that the roller always assumes a position parallel to the fixed roller when in contact therewith. A water trough and a soda trough are mechanically brought alternately beneath the rollers in the usual way, the water being evacuated through a pipe, the lower end of which is successively positioned above independent reservoirs by a cam-operated lever. —B.C.I.R.A.

Cellulose Acetate: Dyeing. L. B. Holliday and Co. Ltd. and A. Young, Huddersfield. E.P.244,936.

Cellulose acetate products are dyed by means of the substances obtained by condensing 1-chlor-2 : 4-dinitrobenzene-6-sulphonic acid or 1-chlor-2 : 6-dinitrobenzene-4-sulphonic acid or a salt thereof, with an aromatic amino- or hydroxy-compound. In an example, potassium 1-chlor-2 : 4-dinitro-benzene-6-sulphonate is dissolved in aqueous sodium acetate and aniline run into the boiling liquor. The dyeing may be carried out by immersion of the cellulose acetate in an aqueous solution or suspension of the dyestuff and heating to about 75° C. A little ammonia, Turkey red oil or soap may be added and the goods are finally soaped, rinsed and dried. —B.C.I.R.A.

Dioxane: Application. Akt.-Ges. für Anilin-Fabrikation, Treptow, Berlin. E.P.245,098.

Dioxane is used as a solvent or wetting agent, particularly because of its miscibility with water and the usual organic solvents such as fatty and mineral oils, turpentine,

benzine, solvent naphtha, and other hydrocarbons. It is a solvent for a variety of products including fats, waxes, solid hydrocarbons, resins, dyestuffs, cellulose esters and ethers, bromine, iodine, phosphorus, sulphur, ferric and mercuric chlorides, boric acid, chromic acid, and, with the addition of a little water, potassium permanganate. Materials such as powders or fibres for spinning are readily wetted if dioxane is added to the water, or if they are previously treated with dioxane. The addition of dioxane to a dyebath enables a material such as felt to be dyed thoroughly. Loose cotton or kapok is freely wetted with a mixture of water and dioxane. —B.C.I.R.A.

Cop-dyeing Machine. F. Kirchhof, Friedek, Silesia. E.P.245,157.

The apparatus comprises a cylinder composed of a number of pivoted segmental plates through which pass perforated pipes upon which the cops are mounted. The cylinder is mounted within a stationary casing on a shaft rotated by bevel gearing. The shaft is hollow and is perforated for that portion of its length within the cylinder and below a hollow cylinder provided to economise the dye, which is circulated from the hollow shaft and is withdrawn by pipes. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Dyeing

245,048. F. Stoffel. Circulatory dyeing process for felt.

5—LAUNDERING AND DRY CLEANING

Patents

Insecticide for Moths. W. Straub. G.P. 419,464 (from *J. Soc. Chem. Ind.*, 1926, **45**, B188).

To remove moths from furs, woollen goods, and the like, a halogenated aromatic acylalkylamide is used such as N-ethylacetamidotrichlorobenzine, either alone, in solution in suitable solvent, or in admixture with a finely-powdered basic substance, such as lime or magnesia, which does not decompose the amide. —B.R.A.W. & W.I.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Laundering

244,914. C. Kingston and W. McChesney. Gearing for rotarily oscillating washing machines.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Artificial Silk Threads: Breaking Load and Extension. *Silk J.*, 1926, **2**, No. 20, 63.

After exposure to a relative humidity of 45% at a temperature of 70° F. for four hours, viscose yarn stretched at a fairly uniform rate until a load of about 44 lb. had been applied. The elongation at this point was about 3·9%. Further load caused a decided change in the slope of the curve though the yarn did not rupture until a load of about 56 lb. had been applied and the stretch had increased to about 13½%. Samples from the same skein after exposure to a relative humidity of 85% at 70° F. showed quite different properties. The yield point was reached at a load of about 10 lb. and elongation of 2% and rupture at a load of about 35 lb. and elongation of 19%. Cellulose acetate yarn gave similar results though the higher humidity had less effect than in the case of the viscose yarn. The results indicate the importance of maintaining constant moisture conditions both in winding and weaving. The stretched yarn has a reduced diameter and when used in cloth it causes thick and thin places, and, when dyed, uneven dyeing. —B.C.I.R.A.

Linen and Cotton; Differentiation of——. *Text. Rec.*, 1926, **43**, No. 516, 48.

Some simple tests for distinguishing linen and cotton are described. A drop of black ink spreads regularly (like oil on paper) on linen but irregularly on fabric containing cotton and linen. Linen is much less susceptible than cotton to the action of concentrated sulphuric acid. Microscopical examination gives the most conclusive evidence. —A.J.H.

Jellies, Elasticity of Gelatine, and its Bearing on Their Physical Structure and Chemical Equilibria. H. J. Poole. *Science Abstracts* (A) 1926, **29**, No. 19, (from *Trans. Faraday Soc.*, 1925, **21**, 114-137).

The strain produced in gelatine jellies by the application of a steady stress is not a function of that stress alone, as in the case with perfectly elastic bodies, but is governed by a time factor, and the results of investigations of this time factor, or "creep" furnish support to the theory that the jellies are two-phase (solid-liquid) systems. The creep is found to be due mainly to a reversible flow of the liquid phase in the interstices of the solid phase, and in less degree to an irreversible plastic deformation of the solid phase. The relationships between the elasticity and the temperature and concentration of these jellies are in qualitative and approximately quantitative accord with a formula deduced from the requirements of such a structure where the solid phase has the form of a mesh of cylindrical fibrils or threads. The assumptions made are that the fibrils are without free ends, and that they are elastic and behave on flexure in the same manner as matter in the gross state; a mathematical assumption is made in order to facilitate calculation. To explain the phenomena observed it is suggested that the material of which the

fibrils are composed is in dynamic equilibrium with the water of the liquid phase as a result either of a reversible hydrolysis or a hydration whereby the ratio between the proportions of gelatine in the solid and liquid phases becomes progressively less as the temperature rises. —L.I.R.A.

Lignin. K. Kurschner. *J. Chem. Soc.*, 1925, **128**, i., 1387 (from *Brennstoff-Chem.*, 1925, **6**, 117-125, 158-162, 177-180, 188-194, 208, 304-311).

A method of preparing pure "lignin" is described in detail. The product gives reactions from which it is possible to regard it as a colloidal coniferin complex with some free coniferin adsorbed on the surface. Previous work on the consitutents of lignin is critically discussed.
—L.I.R.A.

Protective Action of Soaps. S. S. Bhatnagar and others. *J. Chem. Soc.*, 1925, **128**, ii., 1155-1156 (from *J. Indian Chem. Soc.*, 1925, **2**, 11-22).

The protective action of various concentrations of soap on sulphide sols and on solid absorbents has been examined by the drop pipette method. Adsorption of the soap by the sol particles takes place; the adsorbed soap loses its property of dissolving in and lowering the surface tension of water. The facts support the chemical theory of adsorption. —B.L.R.A.

Moisture in Fibrous Materials; Determination of——. C. G. Schwalbe. *J. Soc. Chem. Ind.*, 1926, **45**, B9 (from *Vereins Zellstoff und Papier-Chem.*, 1924, pp. 121-123).

The usual method for the determination of moisture is by heating in a weighing bottle at 105°. Care must be taken that the temperature is equalised in all parts of the oven, and the weighing bottles should not be directly in contact with the metal shelves of the oven. Good exposure of the loosely packed material should be ensured. This method is not accurate in the case of materials containing soluble carbohydrates, such as pectin, or those which are liable to lose volatile constituents other than water, such as resinous woods. The time required is 4-8 hours. By the use of a vacuum weighing bottle the time may be shortened and the temperature of the water-oven will suffice. With suitable apparatus the use of the vacuum may be further supported by the presence of phosphorus pentoxide. The method of distillation in the presence of a hydrocarbon gives results of sufficient accuracy; it is particularly suitable for special cases, e.g., where large samples must be taken or where resinous or fatty materials have to be dealt with. Obermiller recommends for the drying of large bulk samples a water-jacketed oven at 95-100°, a current of air of normal dryness, derived from a source free from the products of combustion, being circulated through the material. This is particularly desirable in the drying of compact materials such as wood pulp.
—L.I.R.A.

"Amsler" Wear Testing Machine. A. J. Amsler & Co. *Text. Mfr.*, 1926, **52**, 54-55.

The wear is produced by pulling a strip of fabric, which is tensioned by a predetermined constant load, to and fro through a comb until it breaks. The number of to and fro movements up to the point of fracture is counted automatically and this number, together with the load on the strip, measures the resistance to wear. The comb consists of four steel plates each 2 mm. thick and arranged parallel and in opposite pairs. The plates have rounded inner edges which bear across the full width of the fabric. —B.C.I.R.A.

Filter Cloths: Resistance. J. W. Hinchley, S. G. M. Ure, and B. W. Clarke. *J. Soc. Chem. Ind.*, 1926, **45**, T1-10.

Experiments on filtration through a simple leaf filter using precipitates of magnesium carbonate, calcium carbonate and barium phosphate prepared by specified methods are described. The following points were investigated—Effect of different filtration pressures, thickness of cake, and composition of prefilt on the structure of the cake; rate of flow of water through cakes of definite thickness; rate of formation of the cake. A number of experiments were made to determine the resistance (r_m) of ordinary filter cloths, or the reciprocal of the number of lbs. of filtrate passing per hour through 1 sq. in. of cloth per lb. per sq. in. pressure. A heavy cloth, chain weave, a fine cloth, twill weave, and a Monel metal cloth, special weave, were used. The curves obtained were of the same general form with a well-defined point of inflection in those for the heavy and fine cloths. —B.C.I.R.A.

Cellulose: Absorption of Alkali. A. Lumsden-Bedingfield. *J. Soc. Chem. Ind.*, 1926, **45**, T36.

Errors in estimations of permanent hardness by Pfeifer and Wartha's method traced to the absorption of caustic soda by the cellulose of the filter paper used. It was found by passing solutions of 0·05% caustic soda through filter paper (Whatman's No. 44), which was subsequently washed with cold and with hot distilled water that 0·040 c.c. of N/5 sodium hydroxide solution was absorbed per filter (9 cm.) in the cold. The absorption with hot washing was less. —B.C.I.R.A.

Cotton and Artificial Silk Fabrics: Regain; Rate of Regain; and Strength. R. G. Parker and D. N. Jackman. *J. Soc. Chem. Ind.*, 1926, **45**, T47-54.

A report of a research dealing with the effects of humidity on the properties of fabrics with special reference to the control

of humidity during strength tests. The work was in three sections (1) the moisture content of the fabrics at equilibrium as measured on a special form of balance described, (2) the rate of absorption of moisture, (3) the bursting strength as measured on the Mullen tester. The measurements were carried out at relative humidities of 50, 60, 70, and 80%. Curves are given for a number of washing fabrics, including cotton, celanese, and viscose, showing (1) the moisture content at different humidities, (2) the rate of moisture regain, (3) the strength of fabric in relation to the change in relative humidity, and (4) the rise or fall in strength in relation to moisture content. The strength of a number of fabrics as affected by treatment with aqueous solutions is shown; the fabrics being tested immediately on removal from the bath. —B.C.I.R.A.

Salicylic Acid: Volatility. A. F. Lerrigo. *Analyst*, 1926, **51**, 79.

Salicylic acid does not volatilise appreciably below 40° C. Between 50° and 60° C. volatilisation is comparatively rapid. —B.C.I.R.A.

Lignin: Constitution, Estimation, and Properties. M. M. Mehta. *Biochem. J.*, 1925, **19**, 958-978.

From consideration of the reactive groupings of the constituents of lignocellulose, lignin appears to occur in chemical combination with cellulose and related polysaccharides as an aromatic glucoside. The aromatic constituent just before lignification is not of the nature of Czapek's "hadromal," but is later converted by oxidation into substances of that nature. Vanillin is the most sensitive reagent for localising the aromatic constituent. Lignocellulose is resolved completely, without decomposition of the lignin, by heating with 4% sodium hydroxide at 10 atmos. for 1 hour. Lignin is precipitated by acidification and isolated by extraction with alcohol. Lignin, as it occurs in wood, can be partly extracted by alcohol, but the major part is in combination with polysaccharides which can be resolved by alkali. Minute quantities of lignin can be estimated colorimetrically by a reagent consisting of phosphotungstic and phosphomolybdic acids in phosphoric acid. It gives a deep blue colour in the presence of sodium carbonate solution. Lignin as isolated from wood is a brown, amorphous, faintly acidic substance melting at 170°. It is insoluble in water and soluble in dilute alkalis and in alcohol. Its iodine value is 139 and acid value 477. It gives insoluble salts of indefinite composition with alkaline earth metals. When lignocellulose is resolved by sodium hydroxide, a residue of pure resistant cellulose—α is [illegible] —B.C.I.R.A.

Modern Views on Cotton. A. J. Hall. *Dyer and Calico Printer*, 1926, **55**, 144-145.

Deals with impurities in raw cotton. The removal of fats and waxes is assisted by mechanical or chemical disintegration of the cotton fibres and this suggests that accessibility to the impurities in fibres varies according to their distribution. The phosphorus content of cotton is dependent on its type, and within limits different types of cotton may be distinguished by their phosphorus contents. Immature cotton contains more phosphorus than mature cotton. —A.J.H.

Artificial Silks: Identification. O. S. Rhodes. *J. Text. Inst.*, 1926, **17**, T75-76. —B.C.I.R.A.

Raw Cottons: Ash Content and Ash Alkalinity. R. G. Fargher and M. E. Probert. *J. Text. Inst.*, 1926, **17**, T46-52. —B.C.I.R.A.

Union Fabric: Analysis. A. T. King. *J. Text. Inst.*, 1926, **17**, T66-67. —B.C.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR &c.

Peruvian Cotton: Classification. *Int. Cotton Bull.*, 1925, **4**, 113-114.

According to the tables for raw cotton export, Peruvian cotton is classified as follows—Rough (white and brown), semi-rough, semi-rough de Huánuco, Mitafifi (white and brown), Tanguis, Smooth Egypto (white and brown), and Sakellarides. Of the total exports, Jan-April 1925, Tanguis represented 80% by weight, and for the corresponding period in 1924 only about 40%. At the same time, the total exports for the period have risen from 3½ to 5½ million kilos. —B.C.I.R.A.

Egyptian Cotton: Production. *Int. Cotton Bull.*, 1925, **4**, 81-82.

The Alexandria General Produce Association reports a total acreage for the 1925 crop of 1,924,382 feddans as compared with 1,787,843 feddans and 1,588,100 feddans in 1924 and 1923 respectively. Upper Egypt reports an increase over last year of 38,000 feddans, and lower Egypt an increase of 100,000 feddans. Of the total, 1,128,946 feddans are under Sakel, i.e., an increase of 256,000 feddans, and the Ashmouni and Zagora has decreased by 125,000 feddans to 659,420 feddans. Afifi Assil has lost popularity, and only 8,384 feddans are sown compared with 22,271 feddans in 1924 and 12,845 feddans in 1923. The Pilion acreage almost doubled and stands at 72,799 feddans. —B.C.I.R.A.

Cotton in the U.S.A.: Costs of Production. L. E. Long and C. R. Swinson. *Int. Cotton Bull.*, 1925, **4**, 36-47.

A survey of costs for the 1923 crop on 777 farms situated in 15 different counties in

the 8 most important cotton States shows all the details of costs expressed as averages for each county. In addition, tables 6 and 7 show for the 777 farms (1) the kinds of poison used, dates of application, and number of applications for weevils and army worms; and (2) weevil control methods other than poisoning advocated by the growers. Of sprays and dusts, 15 different types were used, and the complementary methods for boll weevil control number 20. —B.C.I.R.A.

American Cotton: Wastage from Farm to Spinner. C. L. Stealey. *Int. Cotton Bull.*, 1925, **4**, 48-53.

It is calculated that 30% of the price paid by American spinners is for unnecessary and wasteful services and profits, such as freight, excess tare arrangement, excess moisture, loss of loose cotton, country damage, two unnecessary compress charges, excessive insurance, inaccurate sampling, excessive warehouse charges &c.
—B.C.I.R.A.

Cotton in Oklahoma: Co-operative Marketing. *Int. Cotton Bull.*, 1925, **4**, 53-55.

The Oklahoma Cotton Growers' Association, with 15,086 members, dealt with 141,440 bales for the season 1924-25, or 9 bales per member. The average Oklahoma price per lb. was 23·66 cents and the average price paid to members was 22·77 cents. All expenses of marketing came to 4·97 dollars per bale, and making allowance for departmental income the net cost of the season's business was 3·34 dollars per bale. A table shows the 79 pools into which the cotton was divided. The largest pools were of 12,505 bales of 1-inch cotton, spotted, middling grade; 12,380 bales of 1 in. white of middling grade; 8,673 $\frac{7}{8}$ in. spotted middling grade; 8,454 $\frac{7}{8}$ in. white middling; 7,755 $\frac{7}{8}$ in. strict low middling; 7,395 bales of 1 in. white, strict middling, and 4,553 bales of $1\frac{1}{16}$ in. white middling. According to staple length classification, the Association sold 22,694 bales of $1\frac{1}{16}$ in., 69,642 of 1 in., 41,726 of $\frac{7}{8}$ in., and 7,025 of short cotton. The average season prices per lb. for all the pools are given. —B.C.I.R.A.

Cotton in the U.S.A.: Co-operative Marketing. *Int. Cotton Bull.*, 1925, **4**, 56.

A list of the American co-operative cotton growers' associations, with quantities of cotton dealt with in the last three years, is given. The total cotton sales increased from 753,849 bales in 1922-23 to 1,125,376 bales in 1924-25. —B.C.I.R.A.

Cotton Bale: Tare Standardisation in the U.S.A. E. A. Beveridge. *Int. Cotton Bull.*, 1925, **4**, 56-60.

Of the twenty to thirty prominent markets in the U.S.A., no two have the same tare standards or tare rules; and the differences and difficulties of standardisation may be largely set down to the selling of cotton on gross weight of bales instead of on net weight of cotton in them. Details are given of the various practices and probable standard methods are discussed.
—B.C.I.R.A.

Mississippi Delta Cotton: Grading. *Int. Cotton Bull.*, 1925, **4**, 62-63.

The percentages of the different staple lengths grown in the Delta in 1924-25 were as follows—

Staple in Inches	Percentage of Crop	Staple in Inches	Percentage of Crop
$\frac{7}{8}$	3·01	$1\frac{1}{8}$	38·81
1	3·82	$1\frac{1}{8}$-$1\frac{3}{16}$	25·50
1-$1\frac{1}{16}$	1·73	$1\frac{3}{16}$	7·84
$1\frac{1}{16}$	2·41	$1\frac{3}{16}$-$1\frac{1}{4}$	3·00
$1\frac{1}{16}$-$1\frac{1}{8}$	13·37	$1\frac{1}{4}$	·33
—	—	$1\frac{1}{4}$-$1\frac{5}{16}$	·05

A table is also given by the Staple Cotton Co-operative Association, Greenwood, Mississippi, showing average basis prices, and premiums for 148 different pools. To the grade classification is added one for cotton inferior to ordinary, known as inferior or dogs. Four grades of colour are also recognised, namely *white, wax, vim,* and *blue*; and *gin-cut* and *tinged* cotton have also separate pools.
—B.C.I.R.A.

Sea Island Cotton: Grading in the U.S.A. *Int. Cotton Bull.*, 1925, **4**, 66.

Official Sea Island Standards were established by the Secretary of Agriculture on 25th October 1918, and they were discontinued by order dated 22nd January 1925, for the reason that the crops of Sea Island had become so small as not to justify special provision for it in the official standards. —B.C.I.R.A.

Cotton Picking in the U.S.A. A. S. Pearse. *Int. Cotton Bull.*, 1925, **4**, 8-9.

The practice of pulling the whole boll instead of picking the cotton clean from the boll is becoming more general. This method, known as snapping, allows quicker picking, less waste, and less costs. Ordinary picking in Oklahoma costs 40 dollars a bale in wages; snapping costs 25 dollars. An additional cost of 5 dollars a bale is incurred for boll breaking and cleaning prior to ginning. The J. L. Hart Cotton Machine Company, Chickasha, Oklahoma, produces machines which removed 95% of the foreign matter, and much of the subsequently ginned cotton was classed last year as middling. The early rush of picking this year owing to the drought and the labour shortage led to snapping right from the beginning of the season in Oklahoma. One of the main advantages is that the cotton usually left in the fields at the end of the season will be saved. This loss was found to average 10 lb. per acre in 1923. Moreover, a cotton snapping machine should be relatively simple to devise and the possibility of mechanical picking is thereby improved.—B.C.I.R.A.

Cotton Cultivation in the S.W. States of U.S.A. A. S. Pearse. *Int. Cotton Bull.*, 1925, 4, 10.

Of the 1924 crop, 438,041 bales were produced in areas of W. Texas, New Mexico, Arizona, and California, that, prior to 1914, grew no cotton at all. Several experts maintain that within the next ten years the West of Texas is likely to produce 5,000,000 bales, and the area is certainly attracting the Eastern State farmers. This year, there are 100,000 acres newly put under cultivation in the San Joaquin Valley north of Bakersfield, California; and in this area yields of as much as 1½ bales to the acre of Acala full 1⅛ in., were picked in 1924. The Californian Legislature prohibits the growing of more than one variety of cotton in a district. —B.C.I.R.A.

Cotton: Co-operative Marketing in the U.S.A. A. S. Pearse. *Int. Cotton Bull.*, 1925, 4, pp 2-5 and 13.

Cost of production, and thereby cost of raw material to the spinner when marketed direct, is reduced by the Co-operative Farmers' organisations. The pool system offers the further advantage of providing a constant supply of even running lots. Both the pool advantages and the reduced costs are, however, lost to some degree, where the co-operative cotton is eventually marketed through ordinary brokers and merchants. Direct contact between spinner and co-operative organisation is therefore advantageous, but only 10% is marketed in this way up to the present. The Staple Cotton Co-operative Association, Mississippi, sold direct to spinners in Italy 7,000 bales, Holland 1,000, Spain 1,000, and to U.S.A. mills 109,920. This organisation had 144 pools last year, and publishes daily the price for each of its 11 types. An increase of 100,000 bales of staple cotton in the Mississippi Delta is expected. —B.C.I.R.A.

Cotton Co-operative Marketing in the U.S.A. J. T. Orr. *Int. Cotton Bull.*, 1925, 3, 647-652.

Aims and purposes of the American Cotton Growers' Exchange, with some details of finance and marketing, are described. —B.C.I.R.A.

Cotton Crop Reports in the U.S.A. W. A. Schoenfeld. *Int. Cotton Bull.*, 1925, 3, 658-675.

A description of the American Government Cotton Crop Reports, their origin, preparation, and release. —B.C.I.R.A.

Cotton: Costs of Production in the U.S.A. M. R. Cooper. *Int. Cotton Bull.*, 1925, 3, 680-683.

Costs of production by 14 yield groups, the lowest at 20 lb. and under, and highest at 501 lb. and over, for 1923 in the U.S.A. belt are tabulated. Details of cost per acre for each operation, from preparing the land to ginning are given, and the net cost of lint per acre and per lb. is calculated. The highest cost, namely for the group 20 lb. and under, is 1·45 dollars, and the lowest 9 cents. The average yield for the 1923 crop was about 131 lbs. per acre, and cost of producing in this yield group was 22 cents. The costs include charges for the farmer's labour and that of his family, and a charge for the use of land on a cash rental basis. These costs are derived from the carefully-kept accounts of 2,519 farms. —B.C.I.R.A.

Cotton Production in the Turkish Republic. H. Husni Bey. *Int. Cotton Bull.*, 1925, 3, 632-636.

The cotton of Smyrna is known to Continental spinners as "Souboudga." It is of excellent colour and in 1864, during the Civil War of America, 64,000 bales were imported into Liverpool. Pre-war production fluctuated from 30,000 to 45,000 bales. During the war it shrunk considerably, and during the Greek occupation it fell to 5,000 bales. The present crop is 27,000 and next season's crops may reach 35,000 to 40,000 bales. Cotton for domestic purposes is grown as far north as Adrianople, where experiments are being conducted; small commercial quantities of cotton are produced in the protected valleys of Gallipoli and along part of the R. Sackharia. Cotton is also grown on a small scale near the Persian, Russian, and Iraq frontiers. Increases are reported from all these districts, but the most rapid extension will continue to take place in the Adana region where the present crop is 90,000 bales. The cost of production generally in Adana is estimated at 5d. a lb. plus an 8% levy in kind as a Government tax. The difficulty of mechanically separating the lint from the closed boll, which is the distinctive feature of 90 per cent. of the crop, is now thought definitely solved, so that the check to expansion occasioned by the insufficiency of labour to separate the lint by hand is removed. The pink boll-worm and the cotton boll-worm have appeared, but measures are being taken to combat them. These pests, together with the excessive rains experienced in the Adana district, spoilt the prospects for a much larger crop than the 90,000 bales actually obtained. —B.C.I.R.A.

Cotton Production in the Portuguese Colonies. H. P. Taveira. *Int. Cotton Bull.*, 1925, 3, 626.

Figures from Angola show that yields fell enormously from 1880 onwards. The 1921 crop of 1,800 bales again reached the level of the seventies. The 1922 crop was 3,300 bales. Similar improvement is reported from Mozambique, where 960 bales passed through in 1920. Data by districts are quoted. —B.C.I.R.A.

Cotton Stocks: Monthly Carry-over Statistics. J. A. Todd. *Empire Cotton Growing Review*, 1926, **3**, 50-56.

The available sources of information with respect to the monthly carry-over of American cotton are discussed. Two tables and a figure are given, the latter showing the world's carry-over month by month. The cotton trade makes little use of the statistics available on this subject, and a very valuable indication of the trend of supply is thereby lost. —B.C.I.R.A.

Cotton Prices. J. A. Todd. *Empire Cotton Growing Review*, 1925, **2**, 353-356.

Tables show (1) the history of Sea Island, Brazilian, American, Indian, and Egyptian prices from 1899-1925; (2) Monthly spot prices of American and Egyptian cotton in Liverpool, Alexandria, and New Orleans from August 1922 to August 1925; and (3) Monthly spot prices of various kinds of cotton in Liverpool, 1922-1925. —B.C.I.R.A.

Cotton Cultivation in Nyasaland. H. C. Sampson. *Empire Cotton Growing Review*, 1925, **2**, 317-322.

Adaptations of methods and implements used in native Indian agriculture to the soil, and the labour conditions of East Africa are described. The advantages of the implements lie in their cheapness in making and running, their low cost in working and the ease with which they are repaired. —B.C.I.R.A.

Cotton Production in the Sudan during 1925-26. *Int. Cotton Bull.*, 1926, **4**, 246.

The aggregate preliminary estimate of Sakellarides for the whole country is 307,800 kantars, and of American 109,700 kantars, i.e., 60,000 and 20,000 bales of 500 lb. each approximately. A falling-off at Tokar and Kassala, and in the Blue Nile and Fung Provinces is reported; but rain grown cotton in the Bahr-el-Ghazal and cotton under irrigation at Berber and Dongola (North of Khartoum) have done very well. The Gezira promises 260,000 kantars of Sakellarides. —B.C.I.R.A.

Cotton Production in Syria in 1925. *Int. Cotton Bull.*, 1926, **4**, 246.

The crop is estimated at 25,450 quintals of 220 lb. each, i.e., 11,198 bales of 500 lb. —B.C.I.R.A.

Cotton Cultivation in Turkey (Adana). *Int. Cotton Bull.*, 1926, **4**, 247.

Estimates for the Adana reach the figures of 2,000,000 acres annually, and the production of 1,500,000 bales. The Deltas of the rivers Yeshil and Kizil Irmak in the Smyrna region are thought possible of growing a similar quantity. French interest and American capital and mechanical equipment are special features of the development. France is the chief consumer of Turkish cotton. —B.C.I.R.A.

Cotton Lint: Application. E. C. de Segundo. *Int. Cotton Bull.*, 1926, **4**, 252-255.

The economic advantages of saving the short lint, and some de-linting and "defibrating" machines are discussed. —B.C.I.R.A.

Cotton Cultivation in Brazil. *Int. Cotton Bull.*, 1926, 4, 233-234.

Statistics of the acreage and yield of cotton, State by State, for the years 1921-1924 are given. A table also shows the monthly production, home consumption, exports, and stocks for the year 1924-25. —B.C.I.R.A.

Cotton: Co-operative Marketing in N. Carolina. *Int. Cotton Bull.*, 1926, **4**, 200-202.

The function of "The North Carolina Cotton Growers' Sales Corporation," which has been formed to enable direct sale on Buyers' Call, is explained. Advantage will be taken of the cover in the futures market. —B.C.I.R.A.

Cotton Bale Standardisation in U.S.A. E. A. Beveridge. *Int. Cotton Bull.*, 1926, **4**, 204-213.

By adopting tare standardisation a saving of over 6 million dollars on domestic and exported cotton could be made annually in the U.S.A. Variations in State regulations and in the rules of Cotton Exchanges and other markets are responsible for the present irregularities; a synopsis of these rules and regulations is given. Tare is variously fixed on a poundage or on a percentage basis; but the wide range of weights among the American bales, which is illustrated by tables, prevents a uniform practice on the percentage basis. Sale on a basis of true net weight is therefore advocated, instead of gross weights; and this would also remove any incentive to add to tare. Gin-compressed round bales have an advantage of about 1 dollar per bale in the cost of tare alone, besides the savings in freight and insurance; gin-compressed square bales allow the same economies. The superiority of baling in Egypt, India, and other countries is also described, and tare and density figures for the bales are given. The factors on which the trade's opinion is required are stated as the basis for further inquiry and agreement. —B.C.I.R.A.

"Maarad" Cotton Cultivation in Egypt. *Int. Cotton Bull.*, 1926, **4**, 229.

"Maarad" cotton is a variety grown from Arizona Pima seed in Egypt. The estimated crop of Maarad cotton for this year is from 700 to 800 bales of 500 lb. each. —B.C.I.R.A.

Cotton Production in Paraguay. *Int. Cotton Bull.*, 1925, **4**, 109-110.

Contrasted with the previous crop of 16,000 bales, the 1924-25 crop was estimated at 12,600 bales of 478 lbs., the early season forecast was 22,000 bales. Locust attacks shortly after the beginning of the season; destruction by army worm in February and March; and torrential rains at the end of May have almost halved the crop. On an acreage of 10,861 hectares, approximately 2,653,000 kilos. lint cotton were harvested or at the rate of 244 kilos. per hectare (220 lbs. per acre). The 1923 crop on 3,960 hectares produced 3,800,000 kilos., averaging nearly 900 lbs. per acre. —B.C.I.R.A.

Cotton Cultivation in Transcaucasia. *Int. Cotton Bull.*, 1925, **4**, 115-116.

Acreage sown has increased from 1922 to 1925 as follows—2,700, 50,220, 284,580, 366,755. Transcaucasia now supplies one quarter of the Russian cotton industry. —B.C.I.R.A.

Cotton Crop: Condition Reports, and Consumption in U.S.A. A. S. Pearse. *Int. Cotton Bull.*, 1926, **4**, 188-193.

An examination of eleven crop reports, issued from 25th June to 1st December 1925 inclusive, makes it evident that the Crop Reporting Bureau had over-estimated the damage done to the crop by the early season drought; and only gradually has the error been admitted. The percentage basis on which the estimates are worked is held impracticable. "All that is required is a statement early in the season of the acreage to be under cotton in each State, then once a month a forecast of the quantity per State, starting from 1st August until 1st November. After that time the ginners' returns in the present form, plus an estimate by the ginners of the balance remaining to be ginned, would very likely be a more reliable guide than what we are receiving at present." A crop approaching the record of 1914, namely 16,134,930 bales is expected this year; but the rate of U.S.A. and world consumption in general indicates a total year consumption of 15½ to 16 million bales. Spindleage and consumption figures are provided. —B.C.I.R.A.

Round Cotton Bale in the U.S.A.: Advantages. *Int. Cotton Bull.*, 1926, **4**, 197.

The Clayton press now produces a bale 22 in. in diameter, 35 in. long, with a density of 35 lb. to the cubic foot. Round bales are pressed only once at the gin, and are only sampled twice; whilst the high-density square bales are pressed three times and are frequently sampled eight times and oftener. The round bale is covered with deep burlap, which protects the cotton entirely; the tare is only 1 per cent., and there are no hoops. This is a popular form of bale in Europe; and an increase in the number of Clayton round bales can be expected, for 100 new presses are under contract. At present the Clayton presses are mainly situated in Texas. —B.C.I.R.A.

Cotton Cultivation in Argentina. E. L. Tutt. *Int. Cotton Bull.*, 1925, **4**, 95-98.

Besides the difficulty of inadequate population and the difficulties of transport and the presence of the pink boll-worm, the progress of the Argentine cotton industry is especially hindered by the want of an efficient marketing system. Under present conditions it is considered that a material drop in the prices of cotton or one or two bad years more like 1924-25 might be disastrous to the industry. New marketing proposals are under consideration. —B.C.I.R.A.

Cotton Production (1924-25) in Brazil. A. Grieder. *Int. Cotton Bull.*, 1925, **4**, 98-100.

The record Brazilian crop was produced in 1924-25. On an area of 1,597,020 acres 349,267,208 lbs. of lint were produced, yielding on the average 218 lbs. per acre. Of the total production of 698,534 bales (500 lb.) only 32,522 bales were exported, 35,000 bales were probably consumed in hand spinning, and 450,000 bales were spun in the Brazilian mills, leaving the remainder as stock. The yield per acre by States varied from 116 in Espirito Santo and 126 in Rio de Janeiro to 223 lbs. in Maranhao, and 227 lbs. in Sao Paulo. The acreages and yields for 17 States are tabulated. —B.C.I.R.A.

10—MISCELLANEOUS

Microscope Stains: Application. T. H. Fairbrother. *Industrial Chemist*, 1926, **2**, 101-107.

A general article on the chemistry and application of stains for microscope work. The properties of a number of individual stains are discussed. —B.C.I.R.A.

Water Softening. D. Brownlie. *Industrial Chemist*, 1926, **2**, 61-64, 108-112.

Two articles concluding the series on modern British practice in water softening. The author deals with the advantages and disadvantages of zeolite methods of water softening and describes the Boby-Azed, Standard Kennicott, and Permutit zeolite plants. —B.C.I.R.A.

Colloid Mills. S. P. Schotz. *Chem. Age*, 1926, **14**, 99-101.

A summary of the chief characteristics of colloid mills and the Carter Emulsifier, the Circulator Mill, the Premier Mill, the Hurrell Homogeniser, the Plauson Mill, and the Kek Mill are briefly described. The chief applications of colloid mills are indicated. —B.C.I.R.A.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Silk Industry in Greece. *Silk* (N.Y.), 1925, **18**, No. 8, p. 36.

In 1923 the production of dry cocoons was 694,000 kg., in 1924 it was 880,000 kg. The increase was due to the intensive work of refugees. The greater part is exported. In the two years reviewed the silk produced at home was 57,500 kilos., valued at 45,000,000 dr. and 75,000 kilos valued at 51,700,000 dr. The best cocoons are produced in Tyrnavo; the cocoons of Eubi, being low in silk, are used for seed. Greek and Armenian refugees from Brussa are introducing the industry into Western Thrace, and Greece is now exporting seed to Persia and Caucasia, whose supplies were formerly obtained from Brussa. Efforts were being made still further to extend the industry, as it may become an important factor in national economy.
—F.G.P.

Some Recent Researches on the Stifling of Chrysalides with Chloropicrin. *Silk* (N.Y.), 1925, **18**, No. 11, p. 39.

The summary of conclusions shows that there is no difference in the strength and boil-off of silk from cocoons treated with chloropicrin, dry heat, or steam. The insects are very sensitive to the vapour, and exposure for one hour at 68° F. is sufficient. In the air the odour of chloropicrin rapidly passes off. Cocoon raisers may do the work themselves very easily and so save expense of intermediaries, and there is no risk of overheating, and no complicated machinery is necessary.
—F.G.P.

Measurements: A Comparison of, of Diameters of Wool Fibres with the Micro-Balance and the Projecting Microscope, with Applications to the Determination of Density and Medulla (Kemp) Composition. S. G. Barker and A. T. King. *J. Text. Inst.*, 1926, **17**, T68-T74.

(C)—Vegetable

Cotton Cultivation in China. B. Y. Lee. *Cotton* (U.S.A.), 1925, **90**, 129-131.

Cotton is cultivated to some extent in almost every province of China, the four most important centres, which together produce more than 50% of the country's total, being: Kiangsu province, in which is Shanghai, Chihli province in which is Tientsin, Hupeh province in which is Hankow, and Shantung province in which is Tsingtao. Fungchow is one of the largest cotton growing areas of the Kiangsu province. Its cotton is of very high quality, comparing with American Middling. It is white and clean and is hand ginned. Its staple length is ¾ to 1 inch and it is soft and fairly strong. In the Chihli province the cotton is of a fairly good colour but very wiry; its staple length is from ½ to ¾ inch. The Hupeh province cotton has the same staple length but is less wiry. Cotton from the Shantung province has a staple length of only ½ inch; it is wiry and less white than that from the other provinces. The introduction of American seed has led to excellent results in some provinces. Extensive areas of good soil are still available for development and with the application of scientific methods of cultivating and encouragement of the farmers, the annual production could be materially increased. The Japanese take about 85% of the exported Chinese cotton. —B.C.I.R.A.

Cotton Leaf Tissue Fluids: Sulphate Content. J. A. Harris, C. T. Hoffman, and W. F. Hoffman. *J. Agric. Res.*, 1925, **31**, 653-661.

The sulphate content of the leaf tissue fluids of Upland varieties was investigated in comparison with that of Egyptian (Pima) cotton grown under irrigation in Arizona. The sulphate content of the Upland varieties was the greater, the value for the Egyptian being only 18-28% of the Upland value. —B.C.I.R.A.

Cotton Root Rot in Arizona; Experiments on the——. C. J. King and H. F. Loomis. *J. Agric. Research*, 1926, **32**, 297-310.

Root rot caused by the fungus *Phymatatrichum omnivorum* causes a serious disease of cotton and the economic plants in Southern Arizona. Preventative measures found successful in Texas cannot be applied in Arizona owing to the continued growth of the cotton plants until winter months. Experiments covering a period of four years were conducted in which the effects of farmyard manure and other organic materials were tested. In manured rows the incidence of the disease was considerably delayed, and as a result many plants which had partially decayed roots produced a full crop. It is suggested that, although the fungus may be little affected by this application of organic substances, the plants themselves as a result of the treatment are more able to resist the attacks of the disease organism. —I.C.

Cotton Aphid, American: Life History. E. M. Patch. *Science*, 1925, **62**, 510.

Experiments conducted with species of the cotton aphid, *Aphis gossypii*, indicate the possibility that the winter host of this pest is the orpine plant *Sedum telephium*.
—B.C.I.R.A.

Henequin and Sisal; Breeding Work with——. R. Vidal. *Bot. Absts.*, 1926, **15**, 405 (from *J. Heredity*, 1925, **16**, 9-12).

Crosses between *Agave fourcroydes* and *A. sisalana* are reported. It is hoped that some of the hybrid plants may combine the good points of both parents. Hybridisation of *Agava* offers a number of practical difficulties and the technique is described. The F_1 plants show unusual diversity.
—L.I.R.A.

Cellulose and Starch: X-ray Structure. O. L. Sponsler. *Science*, 1925, **62**, 547-548.

Notes are given from a study of the X-ray diffraction lines given by cell wall cellulose and hemicellulose, starch grains &c. The dimensions of the interplanar spacings are such as to suggest the presence of uniformly arranged structural units approaching in size that of a C_6 carbohydrate group, and the author regards the C_6 group as the structural unit in starch grains and plant fibres. —B.C.I.R.A.

Cellulose: Decomposition by Fungi. H. Heukelekian and S. A. Waksman. *J. Biol. Chem.*, 1925, **66**, 323-342.

The carbon and nitrogen transformations in the decomposition of cellulose by two typical soil fungi, a *Trichoderma* and a *Penicillium*, have been studied. It has been found that cellulose is completely decomposed by these organisms, giving carbon dioxide as the only waste product. No intermediary products are left in the medium. A considerable part of the carbon of the cellulose is reassimilated by these organisms and built into protoplasm. These results have been obtained both in a direct and indirect way. It has been conclusively shown that the carbon evolved as carbon dioxide and the carbon assimilated by the fungi account for nearly all of the carbon of the cellulose decomposed. The carbon and nitrogen assimilated by the organisms show a definite relationship to one another. The organisms prefer ammonia to nitrate as a source of nitrogen. This is assimilated and transformed into microbial protoplasm. A direct correlation is thus found between the amount of cellulose decomposed and the amount of nitrogen transformed into an insoluble organic form.
—B.C.I.R.A.

X-ray Diffraction Patterns from Plant Fibres. O. L. Sponsler. *J. Gen. Physiol.*, 1925, **9**, 221-233.

The structural units in the wall of the (ramie) fibre form a space lattice, the elementary cell of which is an orthorhombic structure. Certain reflecting planes are parallel to the long axis of the fibre, others are transverse, i.e., are at right angles to the long axis and therefore to the longitudinal planes. All the planes are composed of reflecting units, probably groups of atoms, located at the intersections of the planes. This being the case, other reflecting planes must occur at other angles to the long axis. This prediction has been verified. Little can be said as yet concerning the structural unit. If the units were visible they would appear, in a cross-section of the fibre, as closely packed groups of atoms 6·10 Å.μ. from centre to centre in one direction and 5·40 Å.μ. at right angles to that. In a longitudinal section they would appear less compact and might even lose the appearance of groups in forming long strings of atoms which would extend lengthwise of the fibre. —E.A.F.

Accumulation of Brilliant Cresyl Blue in the Sap of Living Cells of Nitella in the Presence of NH_3. M. Irwin. *J. Gen. Physiol.*, 1925, **9**, 235-253.

The rate of accumulation is lower when the cells are placed in the dye solution in the absence of NH_4Cl than when NH_4Cl is present. This decrease occurs without any alteration of *p*H of the sap. It is due primarily to the presence of NH_4Cl in the sap and does not exist when NH_3 is present only in the external solution. —E.A.F.

The Penetration of CO_2 into Living Protoplasm. W. J. V. Osterhout and M. J. Dorcas. *J. Gen. Physiol.*, 1925, **9**, 255-267.

Little or no CO_2 appears to enter normal cells of *Valonia* except in the form of undissociated molecules. Whenever the interior of a cell is more acid than the surrounding medium (excess base being the same in both) we may expect that at equilibrium the internal concentration of CO_2 will be less than the external.
—E.A.F.

Germination of Tobacco Seed: Effect of Sulphuric Acid Treatment. T. H. Goodspeed. . *Univ. of California Publications in Botany*, 1913, **5**, 199-222.

High percentage germination was obtained with seed up to eight years old, and rapidity of germination was found to be a varietal character, independent of age of seed. An increased amount of germination has been found in hybrid seed as compared with seed of the parental varieties. Experiments with acid treatment showed that while concentrated sulphuric acid rapidly killed the seed, the action of 80% sulphuric acid for 10-12 minutes had a markedly beneficial effect on the amount of germination. The best results were obtained if, after treatment, the seeds were washed for not more than 45 minutes in running water; washing for long periods, e.g., 20 hours, considerably lowers the percentage of germination.
—R.W.M.

Growth of Parasitic Fungi: Temperature Relations. H. F. Fawcett. *Univ. of California Publications in Agric. Science*, 1921, **4**, 183-232.

The four fungi used for this investigation were *Pythiacystis citrophthora*, *Phytophthora terrestria*, *Phomopsis citri*, and

Diplodia natalensis. Cultures were made on corn meal agar plates under strictly controlled conditions and tables are given of the daily rate of enlargement of the mycelial discs at fixed temperatures. It was found that for cultures of any age the optimum temperature for growth is near the upper limit of the tempe ature range of the organism in question, but the relation between the optimum temperature and the total range varies for different species. As the age of a culture increases both the optimum and the maximum temperatures for growth become lower. The value of the temperature coefficient (ratio of rate of growth at a given temperature to that at a temperature 10° lower) varies according to the temperature range under consideration. It is greatest at low temperatures and regularly decreases in passing up the temperature scale. —R.W.M.

Cotton Hair: Lustre. G. A. R. Foster. *J. Text. Inst.*, 1926, **17**, T77-81.

(D)—Artificial

"Celta"; Properties of——. *Chem. Abs.*, 1926, **20**, 507 (from *Text. World*, 1925, **68**, 3687).

Celta is a hollow or macaroni-shaped Swiss viscose rayon. It has a rough surface and less lustre than most rayons, a warm silky feel, different from other rayons, and a silk-like appearance in fabrics. It dyes in the same manner as viscose, which it does not quite equal in strength and elasticity. —B.L.R.A.

Artificial Silk: Application. A. H. Grimshaw. *Text. World*, 1925, **68**, 2503-2505 and 2951-2953.

Practical notes on the processes concerned in the spinning and weaving of artificial silk. The notes are based on the observation of successful methods in various mills and on experiments at the New Bedford Textile School. —B.C.I.R.A.

New Type of Artificial Silk for Use with Wool. *Color Trade Jl.*, 1925, **16**, 28.

A Bradford association of woollen manufacturers is said to be making a new form of rayon that can be used satisfactorily in warp and weft yarns of worsted dress goods in the proportion of 1 part to 2 parts of wool. The ordinary rayon fibres are too metallic in lustre and too hard. —F.G.P.

French Increase in Production of Artificial Silk. *Chemicals* (Dyestuffs), 1925, **24**, 159.

A new company has been formed near Roanne (Loire) to build a factory that will employ 1,000 workpeople. It is expected that the output will be consumed locally owing to the increasing use of rayon in Loire textile industry. —F.G.P.

Danish Artificial Silk. *Chemicals* (Dyestuffs), 1925, **24**, 159.

A large clothing and carpet factory has been experimenting with rayon with such success that a subsidiary company has been formed with a capital of 1,000,000 kr. to produce 300 kg. rayon daily. The rayon at present on the Danish market is chiefly English. —F.G.P.

Artificial Silk Production in the Balkans. *Chemicals* (Dyestuffs), 1925, **24**, 83.

For Balkans read Greece; a factory is being built in Athens by a company with a capital of 7 million dr., half of which is earmarked for machinery. The output is expected to be from 600-1000 kg. daily. The greater part of the machinery is to be German, being 20-30% cheaper than French or English. The raw material will be obtained locally. The yarn will be exported to Italy and Egypt. —F.G.P.

Patents

Apparatus for Preparing Alkali Cellulose in Artificial Silk Spinning. La Soie de Compeigne. F.P.589,361.

A tank contains horizontal sheet iron stands upon which are placed the substances to be treated. These stands lie upon swinging brackets, coupled to the walls of the tank and maintained horizontal by springs. The tank is supported by a carriage. —Bur. Text.

Electric Driving of Spindles in Artificial Silk Spinning. La Soie de Valenciennes. F.P.589,370.

Comprises a motor, the stator of which is supported by a stock attached to a bush into which the spindle is fixed. The lower part of the spindle turns in a socket fixed to the frame. A governor is interposed between an adjustable cap screwed upon a bell supported by the frame, and the lower part of the brush fixed upon the spindle. The rotor is fixed upon the bush at the height where the driving notch is generally set. —Bur. Text.

Viscose Threads: Manufacture. W. P. Dreaper, Hampstead Heath, London. E.P.245,815.

In the manufacture of viscose silk, &c., yarns resembling those of raw natural silk, the threads are desulphurised in the gel condition by using a bath containing a salt or salt of an alkali metal or metals in proportion, not less than 40% of the saturation value, for example 80% of the saturation value of common salt. A similar addition may be made to the baths used for the dyeing, bleaching, and other treatment of the desulphurised threads, and also to the wash waters. Alternatively, desulphurising and dyeing may be carried out in the same bath, provided that the salt added does not inhibit dyeing by reason of the salting out of the dyestuff. To the final wash water, a sizing material such as soluble starch may be added. The threads are finally dried under tension in skeins, the filaments then temporarily adhering together. —B.C.I.R.A.

Artificial Silk Stretch Spinning Apparatus. J. P. Bemberg A.-G., Barmen, Germany. E.P.246,335.

To enable an apparatus for the stretch-spinning of artificial silk to be used for the spinning of a number of threads, each spinning apparatus is provided at the upper part with a spinning head having a plurality of sets of spinning nozzles, and means such as cones or partitions are provided for keeping separate the thread bundles which leave the apparatus as threads through separate orifices in the lower part of the apparatus. Coagulating liquid may be supplied to the upper part of the vessel, the current dividing into streams corresponding in number with the cones or sections in the spinning apparatus. Alternatively, coagulating liquid may be supplied at the lower part of each section and in part escaping through outlets at the upper part of the apparatus, or it may be supplied to the lower part of one section only, a part of the liquid rising in this section and overflowing into the adjacent section from the lower part of which it escapes. —B.C.I.R.A.

Artifical Silk Cellulose Ester Solutions—Preparation. Soc. pour la Fabrication de la Soie Rhodiaseta, Paris, France. E.P.246,430.

Solutions of cellulose esters and ethers are prepared with the aid of derivatives of thiocyanic acid or isothiocyanates, or with thiocyanic acid itself, either alone or in the presence of water or organic solvents. For example, cellulose acetate is dissolved in acetone, ammonium thiocyanate and water, or in glacial acetic acid, ammonium thiocyanate and water. Other thiocyanates may replace the ammonium compound or double cyanides or the soluble esters of thiocyanic or iso-thiocyanic acid may be used. The solutions obtained are particularly suitable for spinning artificial silk, the filaments being coagulated in water to which salts may be added and from which the solvents may be recovered either by distillation or by addition of a substance which will form a compound of the acetone-bisulphite type.

—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Production of Vegetable Fibres—

245,495. S. Allingham and R. Boby, Ltd. Flax-pulling machine.

Production of Artificial Fibres—

246,102. Bemberg A.-G. Apparatus for filtering artificial silk liquid.

246,423. J. C. Hartogs. Solution for spinning artificial silk.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Oil-sprayed Cotton: Properties. E. H. Hinckley and R. B. Earle. *Amer. Dyestuff Reporter*, 1926, **15**, 13-22.

Oiling is believed to facilitate the cleaning of cotton to a slight extent, but the first distinct advantage is seen in the card room where oiling eliminates practically all lint in the air. In drawing, the tendency to tangling and thick places is reduced because the fibres slip more readily, and in spinning more twist can be put in without affecting the breaking load of the yarn. Production is said to be greater. In scouring, impurities are removed from oiled material more readily than from untreated material and cloth made from oiled yarns remains white longer than that from non-sprayed yarns. No difficulty has been encountered in dyeing cloth made from oil-sprayed cotton. The presence of oil does not interfere with coating and rubberising for the tyre trade. The advantages claimed for the process are supported in a subsequent paper. The amount of oil added is so small and it is so evenly distributed that its use is no disadvantage to the dyer and finisher.

—B.C.I.R.A.

Raw Cotton: Oil-spraying. *Cotton* (U.S.A.), 1925, **90**, 159.

It is emphasised that the oil must be uniformly sprayed on the cotton as it is rolled over in the hoppers and that, after the correct amount has been determined according to the product, the exact quantity must be maintained on each machine by regularly measuring the amount delivered by the pumps. The author uses $\frac{3}{4}$% of oil. Sprayed cotton at first gave no fly at the cards, but this was counteracted by taking out the top mote knife. The flats were set 0·001 to 0·002 of an inch closer. At the drawing frames it was necessary to lighten the draft and slacken the tension as the oiled material seemed to slide through the trumpets more easily. At the slubbers and intermediates the tension had to be slackened and a tooth of twist taken out. The character of the droppings from under the doffer combs of the cards was changed considerably; they consisted mostly of leaf and trash instead of short fibre. In every process a larger quantity of leaf was eliminated and it was possible to use a lower grade of cotton and produce a cleaner finished yarn.

—B.C.I.R.A.

Raw Cotton: Oil-spraying in the U.S.A. "B. W." *Cotton* (U.S.A.), 1926, **90**, 386.

Oil-spraying is not an entirely new practice. In one mill it has been in use for 15 years and the manager is understood to have brought the idea from Germany where it

seemed to be in common use. This mill uses waste and low grade cotton and with every load of waste introduced into the hopper a broom dipped in oil was banged on the edge of the hopper producing a shower of fine particles. The manager did not think much of the use of oil on good cotton and does not use it on the little fresh cotton he runs. The author has discussed the practice with a number of men and the concensus of opinion is that it is good on waste, or on dyed or bleached stock, but of questionable value on good cotton. Spinners running coarse, low, or medium grades favour oil spraying, but those running $\frac{11}{16}$ inch or better, in Middling or higher grade seemed to think oiling unnecessary, if not actually objectionable. —B.C.I.R.A.

Triple Vacuum Card Stripping Device. Abington Textile Machinery Works. *Text. World*, 1925, 68, 3545.

The Cook-Goldsmith patent triple vacuum system strips cards, collects under screenings, flats, strips, picker motes, &c., and does general machinery cleaning as well as floor and wall sweeping. Four cards can be stripped simultaneously so that time and power required are reduced to one-quarter. The advantages of the system are shown to be numerous. —B.C.I.R.A.

(B)—Spinning and Doubling

Core Yarn: Spinning. *Cotton* (U.S.A.), 1926, **90**, 255.

Core yarn is produced on woollen cards or on cotton cards to which a condenser has been added at the front to split the web up into roving and roll it. The roving from the card is then twisted with a regular 30's single yarn on a special twister which has a drum instead of a creel upon which is set the jack spool carrying the card roving. The fine core yarn is placed in a creel under the jack spools and the two are twisted together. The yarn thus produced is ideal for napping. —B.C.I.R.A.

(C)—Subsequent Processes

Electric Yarn Singeing Machine. *Text. Colorist*, 1926, **48**, 120-121.

An electric yarn singeing machine is described and illustrated. —A.J.H.

(D)—Yarns and Cords

Single Yarn: Twist-Contraction Relation. *Bull. Lowell Textile School*, 1925, Series 29, No. 2.

The relation which the twist in a single yarn bears to the contraction which takes place during spinning has been investigated by comparing a measured length of stock delivered from the front roll and the length of yarn wound on the bobbin. The tests were made on a single 13's yarn made from 1 in. S.M. cotton using twist multipliers from 2·75 to 6·75. The results are tabulated and expressed in the form of a curve, and show that the tendency of the yarn to contract grows greater as the twist increases. —B.C.I.R.A.

Patents

New Device for Drafting in Wool Spinning. J. von Trumbach. F.P.588,862.

The press rollers are provided with circumferential grooves, through which the fibres can slide easily, and placed so near together that the separating ribs act as a comb, sinking into the fibrous matters and permitting loose fibres of wool to be spun in the core of the yarn. —Bur. Text.

Ring Frame Building Motion. T. A. and H. A. Boyd, and J. & T. Boyd, Ltd., Shettleston Iron Works, near Glasgow. E.P.245,218.

In spinning and twisting frames of the kind described in Specification 18,507/10, in which the ring rail is reciprocated and the spindle rail is lowered to build the cop by means operated and controlled by a heart cam and lever, a horizontal rail operates the ring rail, which is supported by pokers, and a further rail operates the spindle rail. The ring rail may be fixed and the spindle rail reciprocated to wind parallel bobbins. When winding cops the horizontal rail is traversed by an ordinary heart cam traverse mechanism and the rail which operates the spindle rail is gradually moved, under the control of an ordinary "let-off" motion, by the weight of the spindle rail. When winding parallel bobbins, the heart cam mechanism is disconnected from the horizontal rail and connected to the rail which operates the spindle rail. —B.C.I.R.A.

Scutcher for Cotton &c. F. Prestwich, Manchester Road, Bolton. E.P.245,226.

In this machine the material is fed by a roller to a number of toothed large working cylinders. A small cylinder running in the contrary direction to the large cylinders clears the fibres from one of them and directs them against an adjustable comb, whence they pass over the dust grid to the collecting cages. Grids are arranged under the working cylinders. The grid bars may be finely serrated and their ends may project into cavities formed in the side plates of the machine. A baffle plate is provided. Openings are provided through which air is drawn in. In an alternative arrangement an additional small working cylinder is arranged above the clearing cylinder and runs in the same direction as the working cylinders. —B.C.I.R.A.

Vacuum Card Stripping Mechanism. A. and R. Hargreaves, Brookhouse Lane, Blackburn. E.P.245,265.

Vacuum stripping apparatus for carding engines, &c., comprises a carriage carrying cylinder and doffer suction nozzles, and caused to travel in either direction along a guide by an endless chain, rope, &c., which may be driven from the doffer pulley, the

carriage having mechanism to put into and out of driving connection with the chain, &c., and being automatically put out of driving connection at the end of its travel. —B.C.I.R.A.

Bobbin-holding Cases: Description. Zwicky & Co., Wallisellen, Zurich, Switzerland. E.P.245,382.

In a case for bobbins &c., having compartments arranged in rows and sloping towards the front, each compartment is provided with a feed roller and with hooks to receive and retain the lowermost bobbin. The feed roller, which is of heavy material and of approximately the same diameter as the bobbins, is provided with a flat tongue which projects forwardly to support one or more bobbins. A measuring bar having graduations corresponding to the diameter of the bobbins is provided for ascertaining the number of bobbins in any compartment. —B.C.I.R.A.

Drawing Roller Head. A. G. Koechlin, Basle, Switzerland. E.P.245,647.

The flexible band which supports the fibrous materials between the main drawing rollers is pressed against the bottom middle roller by a non-rotatable spring-pressed roller, which is provided with separately spring-pressed members for each band to allow for irregularities. A positively driven roller arranged as near as possible to the top delivery roller co-operates with the flexible band. Plates for guiding the bands and preventing dust, &c., entering between the bands are provided. Cleaning rollers for the delivery rollers and a cleaning roller common to the bottom feed roller and the flexible band are provided. If additional pressure is exerted on the flexible band by a stirrup or a further spring-pressed roller, the cleaning roller will only act on the top feed roller. A stationary or rotating cleaner is provided for the positively-rotated roller. —B.C.I.R.A.

Cotton Opener. Howard & Bullough, Ltd., J. Bancroft, and W. A. Walsh, Globe Works, Accrington, Lancs. E.P.245,677.

In an opener of the Buckley or similar type the area of the opening leading from the casing to the tube along which the opened cotton is drawn over bars, is made approximately from four to six times greater than usual in such an opener. The smooth upper part of the casing is closely adjacent to the blades of the beater and the bars do not extend over this portion. Adjustable dampers which can be secured in position by wing-nuts are provided at the end of the suction tube. —B.C.I.R.A.

Spinning Frame Flyer. Rockwood Sprinkler Co., Worcester, Mass., U.S.A. E.P.245,695.

The socket of a flyer is provided with a ring and is secured in the head by forcing the metal which surrounds the hole in the head, by means of dies or by rolling into contact with the ring. —B.C.I.R.A.

Drawing Roller. Armstrong Cork Co., Pittsburg, U.S.A. E.P.245,748.

A textile roller, for example, a drawing roll for a spinning frame, has a sleeve formed of artificial cork consisting of resilient compressed flattened cork granules and an elastic binder, the plane of compression being at an angle to the working surface of the roll, and a covering of pliable sheet material, for example, leather. —B.C.I.R.A.

Roller High Draft Mechanism. B. de A. Fonseca, Sao Paulo, Brazil. E.P.245,939.

A pair of freely rotatable small, light rollers is mounted between the middle and front drawing rollers of roving and spinning frames upon brackets secured to the pivoted cap bar, and may each comprise two bosses, or separate rollers may be provided for each sliver. The rollers are of 2 to 6 mms. diameter and are made of light material such as aluminium. The fibres are maintained parallel and the floating fibres are held by the light rollers so as to permit a high draft to be effected. The back rollers are driven from the front rollers by a system of gears and a draft wheel. —B.C.I.R.A.

Condenser Carding Engine Rubbing-Leather: Reciprocating Mechanism. A. Brown and Tweedales & Smalley, Ltd., Castleton, near Manchester. E.P.246,343.

Means for reciprocating the rubbing-leathers of a condenser comprise a pair of parallel shafts connected by skew gearing and mounted in bearings in a box. The lower gear runs in an oil-box and the bearings are oiled through tubes reached by holes in removable plates which can be applied to close the box. The lower shaft is driven through a stepped pulley. Each shaft terminates in a plate provided with an eccentrically arranged socket to accommodate a boss on a crank plate. The throw of the crank is adjusted by turning the crank plate relatively to the other plate and the two are secured by a bolt working in a slot. The cranks are connected by links on the frames carrying the rubbing leathers. The cranks, &c., can be enclosed in a detachable casing. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Preparatory Processes—

245,511. S. Allingham, M. Soenens, and R. Boby, Ltd. Feeding and conveying device for flax.

Spinning—

245,248. W. Prince-Smith and D. Waterhouse. Building motion device.

245,580. R. Walker. Cap rotation prevention device.

246,229. A. Stell and D. Bulay-Watson. Mechanism for production of horse-hair yarns.

246,264. Fairbairn, Lawson, Combe, Barbour, Ltd. Delivery stop motion.

3—CONVERSION OF YARNS INTO FABRICS

(B)—Sizing

Flour Suspensions: Plasticity. P. F. Sharp. *Cereal Chem.*, 1926, **3**, 40-56.

A description is given of an apparatus devised to study the plastic flow of fairly concentrated suspensions of flour in water. For a particular flour (unspecified) the suspension was found to be plastic when it contained 19% or more of flour by weight on the dry basis. —B.C.I.R.A.

Zinc Chloride: Application. Textile Operating Executives of Georgia (Paul Seydel). *Cotton* (U.S.A.), 1925, **89**, 1234-1235.

Zinc salts are said to be among the most efficient antiseptics for preventing mildew; 1%, calculated on the dry size ingredients, is sufficient to prevent mildew under ordinary conditions with not more than 8 or 9% of moisture in the warp. The speaker declared that zinc chloride does not decompose appreciably below 1000° F. and that in his experience it has no dangerous effect whatever in finishing when only 1% is added on the weight of dry size. —B.C.I.R.A.

Slasher Automatic Control Device. *Cotton* (U.S.A.), 1925, **90**, 155-159.

A device which automatically increases the friction on the drive as the loom beam on the front of the slasher fills with yarn. An arm which is attached to the square shaft that holds the press roll against the beam carries a lug which can be fastened at any desired point by means of a set screw. A chain is attached to the lug and passed over the sprocket, the loose end being held by a heavy spring which permits the movement of both arm and chain as the press roll moves. Any movement of the press roll is translated to the weight on the friction lever by means of a ground wheel with the chain running over it. The chain passes over guide rollers on the friction lever and is attached to the control weight. When the press roll is against the empty barrel of a beam the control weight on the friction lever is at such a point that the warp is at the proper tension. As the diameter of the beam increases, forcing the press roll down, the weight is gradually moved along the lever so that the increase in friction is constant. When a new beam is put on the slasher the weight is automatically returned to the starting point. —B.C.I.R.A.

Sizing. P. Seydel. *Cotton* (U.S.A.), 1926, **90**, 217-218.

The first of a proposed series of articles on warp sizing. The author deals with the lack of a dependable method of regulating the moisture content of warps coming from the slasher and commends the practice of covering size kettles, circulating system, ends of slasher drums, and steam pipes with asbestos to maintain an even size mixture and to save steam. —B.C.I.R.A.

Flour Moisture: Estimation. G. C. Spencer. *J. Assoc. Official Agric. Chem.*, 1925, **8**, 667-669.

A method for drying flour in vacuo under standardised conditions is described. It is recommended as a standard or referee method, but requires too much time and expensive apparatus to be of use in routine work in mills and laboratories. In an alternative procedure about 2 grams of flour are accurately weighed into a tared covered dish, the cover is removed and the dish and its contents are heated in an oven at 130° C. for one hour. The cover is replaced and the dish cooled in a desiccator for about 20 minutes before reweighing. This method gives concordant results checking closely with those of the standard vacuum method. —B.C.I.R.A.

Flour Ash: Determination. C. E. Mangels. *J. Assoc. Official Agric. Chem.*, 1925, **8**, 671-675.

The Hertwig-Bailey glycerol method is not recommended. The following method is proposed for adoption as official: Rapidly weigh 5 grams of flour into an ignited, cooled, and weighed crucible. Ignite in a muffle at approximately 550° C., taking care that no portion of the muffle becomes hot enough to fuse the ash. A light, gray, fluffy ash should result. —B.C.I.R.A.

Starch: Estimation. *J. Assoc. Official Agric. Chem.*, 1926, **9**, 31-32.

Practical details are given of a method for estimating starch in the presence of interfering polysaccharides by means of barley malt extract. The method has been adopted as official. —B.C.I.R.A.

Studies on Starch. —. Alsberg. *J. Ind. Eng. Chem.*, 1926, **18**, 190-193.

Corrects the generally accepted view that starch granules burst when heated in water. This is true of potato starch, but not of others. Limited swelling in cold water is due to strength of retaining cuticle; if this is damaged swelling continues. Even slight pressing on cover glass may be sufficient. Large granules will burst more easily than small ones owing to the larger ratio contents area. Thoroughly dried starch swells considerably less than undried. Swelling of granules when boiled: Potato=40 times, canna=16½ times, wheat=8 times, arrowroot=45 times; the first two are large grains and the second two small. Concludes that viscosity of starch paste is due to packing of swollen individual (not burst) granules. Swelling is due to softening of the naturally rigid structure by moist heat. Account of experiments with ground starches. —B.L.R.A.

Skein Sizing versus Warp Sizing. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 11, p. 46.

It is shown that warp sizing gives the better results because it is not possible to size skeins uniformly, and the spots, stains, and streaks may persist through to the finished fabric. A sized skein is frequently handled and thus the coating is disturbed and loom output is decreased. —F.G.P.

Starch Paste: Sizing Value. W. A. Nivling. *Trans. Nat. Assoc. Cotton Mfrs.*, 1924, **116-117**, 190-236.

An explanation of "fluidity" and "viscosity" and a discussion of the connection between these factors and the sizing value of starch pastes. Descriptions are given of the Saybolt, Engler, Bingham and Green, Stormer and Doolittle viscosimeters. The paper also discusses questions of the control of temperature in sizing, penetration (with the help of pictures of cross-sections and teased-out ends of yarns stained with iodine), antiseptics, softeners, &c. —B.C.I.R.A.

Sizes on the Elastic Behaviour of Flax Yarns; The Effect of——. J. A. Matthew. *J. Text. Inst.*, 1926, **17**, T192-T212.

Starch: X-ray Structure. See Section Ic.

(C)—Weaving

New Rayon Shuttle. *Text. American*, 1925, **44**, No. 6, p. 24.

In this shuttle the exacting demand of rayon for a sensitive yet uniform tension has been met, after months of experimenting, by an entirely new device. Another improvement is in the threading eye, where there has been a danger of catching in the crack where wood and metal join. The eye is of brass with a continuous outside leg, thus preventing contact of the thread with the wood or joints. The thread groove has been treated with a new enamel giving a surface not unlike glass, yet sturdy as the brass itself. Among other refinements is the simple expedient of lining the shuttle with fur to counteract the tendency of rayon yarn to balloon. —F.G.P.

Prevention of Damages in Textile Fabrics. *Text. American*, 1925, **44**, No. 1, p. 13.

Cutting of the shoot in crêpe de chine is said to be troubling silk manufacturers in America. It is caused by sharp points on the sand roller which, under the tension, cut partly or wholly through the crêpe twist weft. When the silk is degummed the raw silk warp shows up in the cut places as shiny spots. The remedy is to smooth the sand roller or to substitute a rubber-faced roller. —F.G.P.

Metal Loom Beam Gives Satisfaction. *Silk* (N.Y.), 1925, **18**, No. 11, p. 40.

The all-metal loom beam has shown in actual service that it fully justifies the claims made for it and nearly 100 silk mills are adopting it in place of the old wooden beam. —F.G P.

(D)—Knitting

Draw Stitch: Application. G. R. Merrill. *Text. World*, 1925, **68**, 3083.

The use of the draw stitch in hosiery manufacture, for the production of imitation rib and fancy effects is described. —B.C.I.R.A.

(G)—Fabrics

Tent Fabrics; Life of——. J. A. Hunter. *Chem. Abs.*, 1926, **20**, 827 (from *Text. World*, 1926, **69**, 309-311 and 315).

Experiments by the British Government upon cotton and linen tent fabrics indicate that the heavy tent fabrics are much less affected by the deteriorating influence of sunlight than are the light and much-exposed fabrics used in aeroplane and airship construction. Micro-organisms are the chief enemies of tent fabrics and their effects are most devastating in hot, damp climates. Chemical action is also a factor, and in certain fireproofed fabrics it is the dominant cause of deterioration. The deteriorating action of sunlight, possibly caused by ozone formation, can be diminished by the proper use of pigments which are impervious to light, such as lead chromate. The tannates, tungstates, and sulphides frequently used in fireproofing accelerate the deterioration. Waterproofing frequently, but not always, has a beneficial action, depending upon the process and the materials used and the climatic conditions of exposure. Tables are given showing the tensile strength of waterproofed fabrics and the deterioration under exposure in various climates. Terra cotta-dyed cuprammonium-treated linen is regarded as the best tenting fabric, followed by cutch-dyed cotton. The latter has the greatest water-tightness. —L.I.R.A.

Fabrics of the Day: Gros de Londres. J. Chittick. *Silk* (N.Y.), 1925, **18**, No. 12, p. 43.

"Gros Grain" indicates a large heavy ribbed material; many fabrics are localised in the same way, such as Tours, Naples, Paris, Venise &c. The "London" cloth has alternately coarse and fine cross ribs; it is yarn-dyed, has the usual warp and shoot, and is usually tin weighted. There is a substantial body of warp which covers, without concealing, the weft; six harnesses are required. The fabric has a firm crisp feel and a good but not brilliant lustre, and the ribs stand out well. The warp is two-thread organzine of 13/15 den. and grades of Best Extra are suitable; 200-240 ends per inch, three to the dent are usual. In regular Gros Grains two or more ends of tram are doubled together for the shoot; using 13/15 silk it would be two ends of four-thread, three of three-thread, or four of two-thread; that for the finer rib

is less than the other. It is dyed souple and therefore lacks lustre, but this is largely hidden by the warp. Shot-effects may be produced. In the finishing a light gum is sprayed on and goods are afterwards broken and cylindered. Print warps are sometimes used. This fabric is of excellent durability and appearance and very useful for present day costumes. —F.G.P.

Bolting Cloth. *Silk* (N.Y.), 1925, **18**, No. 12, p. 35.

Efforts have been made in America to replace silk with metal for bolting cloth in flour mills, nor has it been possible to manufacture the silk fabric there, although it is a prime necessity in the most important food industry. The weaving of bolting cloth is confined to Switzerland and Savoy, where it is an hereditary occupation, skill in which is a distinct business asset. It is a home industry carried on round Appenzell and St. Gall, principally; the hand-looms, rather primitive machines, being made by the people themselves. Owing to the extreme fineness of the silk, Adrianople Extra, power looms are not possible. It is slow work, the output for continuous operation being one yard of 40 in. material per day. Weavers earn, at present, about 7 francs (Swiss) a day. The silk is reeled in Italy and thrown with 80 twists per inch, the deniers being 9-11, 10-12, 11-13. It is woven in the gum and the fabric is not boiled-off, sized, or treated in any way. The closest inspection is needed for the least imperfection renders it unfit for use. There are three qualities and 30 numbers. This cloth is admitted to the States free of duty. In England, in addition to its normal use, some is sold for hand painting. (Attempts, a few years ago, to make it here, failed.) It is an interesting fact to note how the flour industry is dependent on the silk industry. —F.G.P.

Fabrics of the Day: Canton Crêpe. J. Chittick. *Silk* (N.Y.), 1925, **18**, No. 8, p. 35.

This is an extra heavy, coarse crêpe de chine; it probably originated in Canton and the local silk would have been used; now any suitable silk is employed. It is made in plain weave with raw silk warp with the shoot alternately two picks right and left twist. Coarser reeds than the usual 60 or 65 dents are used, the threads being bunched in rough groups, and fewer, stouter picks in the weft. The result is that the boiled-off fabric is more open and rippled; 20/22 denier silk is generally used in the warp. Canton silk is considered better for shoot than Japan, as it is substantially finer and helps the feel and draping quality. Highest grade is not necessary if that used, such as Extra or Best Extra, is reasonably clean. A Best No. 1 will do for weft. A width of 45 in. may be required on the loom for 39-40 in. material. A shrinkage of 4-10% warpways should be allowed for, as the greater cost of the loss of length is made up by the increased price obtained. Dyeing must be done carefully as the material is heavy. Spun silk and rayon are sometimes used; in the latter case the draping is not so good, and bad streaks are liable to appear during dyeing. —F.G.P.

Fabrics of the Day: Crêpe Faille. J. Chittick. *Silk* (N.Y.), 1925, **18**, No. 11, p. 37.

"Faille" indicates a ridged cloth and might apply to poplin, bengaline, gros grain, &c., and may be of any fibre. The fabric here noted has organzine warp and crêpe shoot. It has a well-defined but not prominent cross-grain figure with the characteristic pebble of crêpe. It has good lustre without gloss, soft feel, and drapes well. The lustre is increased by exchanging organzine for raw silk, generally 20/22 den., sometimes as high as 26/28 den. There should be sufficient warp properly to cover the shoot and to avoid streakiness. The reeds may vary between 60-75 dents, with 360-450 ends per inch, of double extra white Japan with a heavy weft as in Canton crêpes. The six-thread crêpe twist shoot sometimes used is inadequate; it should be 12-thread 13/15 den., with 55/60 twists. Best No. 1 to Extra, if clean, are suitable. The weaving is two picks each way. A generous allowance for shrinkage is necessary, a loom width of 46/48 in. to give 39/40 in. material; 48 picks to the inch is the best weave. Good picking is necessary. Dyeing follows the usual procedure. If the cloth is to be weighted, corresponding reduction in the size of the silk will be necessary. —F.G.P.

Artificial Silk Developments. *Chemicals* (Dyestuffs), 1925, **24**, 159.

Rayon in the form of fine netting is being used in China, around Shanghai, for caps that fit tightly over the head and keep the hair flat. The same idea is used in England by shingled ladies as a nightcap. —F.G.P.

Artificial Silk Use increasing in India. *Chemicals* (Dyestuffs), 1925, **24**, 159.

In the five months, April to August, the imports of rayon were 800,000 pounds compared with 300,000 pounds in the same period of 1924. It is principally used in hand looms for making saris, the Indian women preferring the brilliant sheen to the dulness of cotton. —F.G.P.

Patents

Double Reed with Intercrossed Teeth for Loom. J. Collard. F.P.589,031.

The teeth are crossed and so set that at the centre of the reed they are at intervals half as great as at the ends. This reed is provided with three legs set at intervals to facilitate access to the teeth.

—Bur. Text.

Electric Picker for Circular Box Loom. C. Vilard. F.P.589,267.

The shuttle, which bears magnetic armatures, slides across under the successive attractions of a series of electro-magnets. the circuits of which are successively closed by a revolving commutator. This comprises on the one hand, two series of fields to which each electro-magnet is connected in reverse order and direct order respectively, and on the other hand two circular fields receiving the current from a distributor driven by the shuttle at each end of its course. —Bur. Text.

Size Softeners: Composition. J. W. Marsh and M. I. Aische, Buglawton, Cheshire. E.P·245,199.

Softeners for size comprise a soap of a fatty acid, a sulpho-fatty acid or an oxy-fatty acid, or any mixture of such soaps, and a hydrated silicate or a substance containing a silicate or silica. Soaps of sodium, potassium, aluminium, magnesium, calcium, manganese, mercury, and zinc are specified, and the silicious materials comprise china clay, allophane, pyrophyllite, talc, steatite, pinite, fullers' earth, okenite, xonalite, apophyllite, and silicic acid. The soap or soaps are dissolved or suspended in water and incorporated with the silicious materials. Deliquescent salts such as the chlorides of zinc, calcium or sodium or potassium carbonates may be added. When neutral soaps are used, preservatives such as sodium β-naphthionate, sodium salicylate, phenolates, or pine tar oil are added. The compositions may also contain small amounts of phenols and solvents such as carbon disulphide, dichloro-, tetrachloro- or pentachloro-ethylene, chloroform or carbon tetrachloride. The size softeners are added to starch, dextrin, flour, &c., and water, with or without fillers. —B.C.I.R.A.

Loom Take-up Motion. J., E., and S. Lilley, Dean Street, Derby. E. P. 245,217.

The take-up roll of a tape loom is driven through worm gearing and a shaft which is mounted in a swivel bearing and a slotted bearing and connected by lever mechanism with the belt shipper so that, on stoppage of the loom, the worm wheel is moved out of engagement with the worm and the warps pull the roll in a backward direction to an extent determined by a pawl. —B.C.I.R.A.

Warp Measuring Mechanism. Howard and Bullough, Ltd., and J. Irving, Globe Works, Accrington, Lancs. E.P.245,271.

The patent relates to cut-marking and measuring devices for slasher sizing machines of the kind having a dial wheel in alternate gear connection with spreading rollers geared to a measuring roller, and in which peg teeth on wheels geared to a wheel on the dial wheel are engaged periodically by a peg tooth on the wheel on the dial wheel, to rock weighted levers adapted to release a hooked disc to allow a shaft to be rotated through a half revolution for operating the marking hammer. According to the invention the shaft is driven frictionally through clutch mechanism when the disc is freed by vibratory levers, the friction drive being non-existent when the hooked disc is again locked. —B.C.I.R.A.

Loom Shuttle. Kirk & Co. Ltd., H. Wrigley, H. Mullineaux, and D. Parkes, Wall Shuttle Works, Blackburn. E,P. 245,288.

A shuttle, which is threaded by passing the weft through slots into a central weft passage and the shuttle eye, has inclined and vertical pins arranged across the enlarged end of the passage to prevent ballooning of the weft. Both pins are arranged out of the direct path of the weft. —B.C.I.R.A.

Loom Dobby Mechanism. J. H. Place, Whalley, Lancs. E.P.245,308.

The motion of the jack levers is controlled by a double-armed peg lever with hubs loosely mounted on an eccentrically-mounted barrel driven by chain gearing, &c., from the crankshaft. The arm, which engages notches in the jack lever, is formed with a dagger and projection and the other arm is controlled by a chain of pegged lags on a barrel, which may be provided with a ratchet wheel engaged by a pawl or be so geared with the eccentrically-mounted barrel mentioned above that if the loom is turned back the correct lag will always be in position. —B.C.I.R.A.

Loom Dobby Mechanism. F. and A. Fielden, Heaton Moor, near Manchester. E.P.245,317.

An auxiliary lattice of the dobby has one or more pegs for raising one end of a lever, the other end of which engages in a slot in, and thereby depresses, a spare dobby peg lever whereby a jack lever is turned. This jack lever may be connected by a chain, &c., to the weft stop motion arm, whereby the loom is stopped, or it may operate the terry motion, or the shuttle box of a multiple box loom, or any other part requiring a periodic or intermittent movement at pre-determined times. —B.C.I.R.A.

Weft-feeler Mechanism. British Northrop Loom Co. Ltd., Daisyfield, Blackburn. E.P.245,328.

The spring-controlled feeler is at times and for certain periods held forwards away from its feeling position by a spring-controlled detent lever having a tooth engaging a tooth on the feeler, the detent lever being periodically tripped, to enable the feeler to move to its feeling position, by a trip which acts on an extension on the detent lever. —B.C.I.R.A.

Compound Gear Wheel Fabric. International General Electric Co., New York, U.S.A. E.P.245,458.

Plates, bars, &c., suitable for the manufacture of gear wheels, are built up of layers of impregnated fabric in such a way that the fibres of each fabric intersect the fibres of the adjoining fabric, both in the warp and in the weft. In the manufacture of a square plate, for example, two webs of fabric of different width are employed, the width of one fabric being equal to the diagonal of a square cut from the second fabric, which has its sides equal to the width of the fabric. By alternating squares of the first and second fabric, a compound fabric may be formed in which the threads of adjoining fabrics intersect at an angle of 45°. By arranging the triangles of the first fabric in pairs to form additional squares, no waste of material is incurred. —B.C.I.R.A.

Circular Knitting Machine Vertical Patterning Mechanism. Trent Engineering Co. Ltd. and W. Lacey, Wilford Crescent East, Nottingham. E.P.245,498.

The patent relates to improvements in vertical striping or patterning attachments. Radially sliding yarn guides of an indicated shape are moved outwards by the action of a cam on graduated butts and are returned by the action of a counter-cam on other butts. The cams are rotatably connected to the lower end of an outer driving sleeve. The cam controlling the graduated butts is moved vertically by means of an intermediate sleeve under control of a pattern chain or cam, to put different guides into action. —B.C.I.R.A.

Heald-threading Machine. Zellweger A.-G., Uster, Switzerland. E.P.245,530.

In a jacquard-controlled warp heddling machine having devices for separating the healds of each harness, each separating device is provided with a feeder adapted to separate a group of healds and to transport them to a place from which a gripping device supplies them singly to a second place where they are presented to members which move towards them and hold them in position during the passage of the threading-needle, each threaded heald being displaced laterally by abutment means rigidly fixed to the needle. After each threading operation, the needle and the abutment means are withdrawn and are then returned to their initial position.

—B.C.I.R.A.

Circular Knitting Machine Patterning Mechanism. Trent Engineering Co. Ltd. and W. Lacey, Wilford Crescent East, Nottingham. E.P.245,558.

The patent relates to striping or patterning attachments consisting of a series of dependent yarn guides acted on by cams and radially reciprocating instruments. Some guides are provided with inner projections and others with projections reaching lower down, whilst some or all guides are provided with graded butts. The inner projections and butts are acted on by one or other of two cams respectively, which are carried on a boss rotatably connected to the driving sleeve. The boss is slidable vertically on the sleeve as described in Specification 217,745. The guides with inner projections may be employed for producing vertical stripes and are unprovided with butts.

—B.C.I.R.A.

Warp Knitting Machine Patterning Mechanism. A. F. R. Bally, Lyons, France. E.P.245,714.

To facilitate the production of patterned fabrics on "jersey looms" by means of pattern chains of standard form, certain horizontally moved bars are controlled each by five or more chains. Two of the chains are carried by an intermittently moving drum and the remainder by a constantly moving drum. One of the two chains is constantly in action on a roller adjustably mounted on a vertical rod pivoted to a slidable shaft. The other of the two chains determines which of the group of chains shall come into action by operating on a roller carried by a lever pivoted and connected by a rod to a support for a series of rollers, the support sliding on a rod. These rollers are staggered laterally and are acted on one at a time by the chains, the movements of the rod being transmitted to a horizontally moved bar by linkwork the constituent parts of which can be adjusted or exchanged to adapt the range of movements to the gauge of the machine.

—B.C.I.R.A.

Warp Stop Motion. O. J. Player, Rockingham, N. Carolina, U.S.A. E.P. 245,724.

A drop wire of the kind having a guide slot to receive the usual guide-bar is provided with a part projecting beyond the side of the upper portion adjoining the slot whereby the wire becomes apparent when it falls, the projection being provided with an opening above the slot for the reception of a hook for raising the drop wire.

—B.C.I.R.A.

Pile Fabric Loom Knotting Device. G. Friedrich, Pinkafield, Austria, and E. Reich, Boraroster, Budapest. E.P. 245,791.

In looms for weaving pile fabrics in which the pile knots are formed around the warps, simultaneously operated jacquard-controlled knotting devices, each commanding a section of the warp threads, are mounted singly or in groups in rockable frames and the operating parts of each knotting device are driven by a common driving shaft extending across the loom. The frames or holders of the knotting devices are pivoted about the shaft and are moved by lead shafts either continuously or step by step after each knotting device has operated. When pile loops have been supplied to the whole width of the warp

sections, the knotting devices are raised to an inoperative position by levers on a common shaft. The pile loops are then beaten up, and after one or more shots of weft have been inserted, a fresh row of pile loops is formed, the knotting devices traversing the warp sections in the same or in the reverse direction. Selvage-forming devices are mounted and driven in a manner similar to that of the knotting devices. Instead of moving the knotting devices across the loom, they may be stationary and the weaving mechanism be moved. —B.C.I.R.A.

Umbrella Cloth: Weaving. J. Bister, Mamaroneck, New York, U.S.A. E.P. 245,885.

Cloth for umbrella covers consists of a cotton weft and a warp of cotton at the middle and silk at the sides. The silk warp threads may be thicker and closer together than the cotton warp threads, are of a different colour, and may overlay several weft threads so as to hide them. The fabric is cut up into triangles. —B.C.I.R.A.

Circular Knitting Machine Sinkers. W. H. C. Spencer, East Park Road, Leicester. E.P.245,928.

Circular machines with horizontal latch needles arranged radially are provided with sinkers movable vertically on the tricked edge of a preferably rotary cylinder attached to the needle bed which is driven from a main shaft by gearing. The sinker cam shell is normally stationary but is capable of circumferential movement on the support for adjustment. The position and shape of the sinkers are such as to permit the web to be passed over the shell without undue strain. The throw of the needles and sinkers can be varied by adjusting the cams which operate them. —B.C.I.R.A.

Shuttle Threading Device. J. E. Haughton, Higher Crumpsall, Manchester. E.P. 245,943.

A threading device for a shuttle comprises two fittings, one acting to guide the weft to an eye and positioned by pins and a lug which enters a slot opening into the eye. The point of the second fitting enters a slot in the top of the first fitting. A downwardly-extending lug has a keyhole slot and is slightly spaced from an upstanding flange having a curved top. The thread is led under the top of the first fitting, round the point of the second fitting, and is then pulled down so as to pass over a lateral pin and the flange, through a slot, and round one of the pins to the eye. —B.C.I.R.A.

Artificial Silk Pile Fabric. Brown, Vickers and Co. Ltd., and S. H. Vickers, Ingleby Road, Bradford. E.P.245,973.

In moquette and other warp pile fabrics, threads of artificial silk waste, &c., alone or mixed with wool, hair, or cotton, &c., are introduced into the pile, either throughout or locally, to form striped areas or patterns, or a mottled effect. The pile fabrics may be woven face to face or singly, the pile being formed over wires and being cut or uncut. Threads of wool or cotton, &c., are used. —B.C.I.R.A.

Circular Knitting Machine Double Loop Stitch Needles. A. de Horevitz, Boulevard Voltaire, Paris. E.P.246,093.

To produce fabrics composed of double loops in certain wales and single loops in others, those needles which are to draw double loops have stepped butts. These butts are thus left at a higher level by the centre cam than the unstepped butts, and the corresponding needles are enabled to take a second yarn whilst the others do not. This yarn is fed by a guide adjustable horizontally on an arm which is adjustable vertically by means of a screw. —B.C.I.R.A.

Loom Beat-up Motion. Bergmann Elektricitäts-Werke A.-G., Leestrasse, Berlin. E.P.246,138.

To keep the beat-up pressure constant at all loom speeds the mechanical pressure is increased when the dynamic pressure falls, and *vice versa*, e.g., by moving the crankshaft operating the slay nearer to or away from the fell. The crankshaft may be eccentrically mounted in a member which is rotated simultaneously with adjustment of the speed control lever of the loom. —B.C.I.R.A.

Warping Creel. J. Gerstberger, Naumburg-on-Queis, Germany. E.P.246,161.

In warping threads from cross-wound bobbins, the creel comprises vertical slats on which the bobbins are mounted, and horizontal slats which carry the thread-tension devices. The bobbins can be introduced between the horizontal slats, and during this operation the threads passing to the guide-bars are placed around clips or hooks on the horizontal slats. —B.C.I.R.A.

Braiding Machine Take-up Mechanism. G. Krenzler Co., Unterbarmen, Germany. E.P.246,163.

The take-up mechanism and the collector guide are carried by an arm slidably mounted on a post. By turning a hand wheel which works screw-and-nut gear, the arm is moved vertically for adjustment. The take-up gear consists of spur gears, bevel gears, and a shaft carrying a worm for driving the take-up roll. The braid is taken round an idler roll. —B.C.I.R.A.

Braiding Machine Bobbin Carriers. G. Krenzler Co., Unterbarmen, Germany. E.P.246,164.

The bobbin carriers of lace machines in which the bobbins are carried round by drivers capable of being stopped and started individually, are provided with pins of such

dimensions in relation to the driving notches that the angle between the line normal to one point of contact and the line joining the two points of contact of the pin with the driving notch is greater than the angle of friction. —B.C.I.R.A.

Circular Knitting Machine Yarn Guide. Mellor, Bromley & Co. Ltd., and T. C. Bromley, Leicester. E.P.246,296.

The yarn is led approximately in a plane that is tangential to the needle circle, the feed plate being slotted to permit this. The yarn bears on a removable pin which may carry a roller or be turned round to vary the surface exposed to wear. The feed plate may be in two parts adjustable by pin and slot connections to vary the width of the space between, through which the yarn is passed. —B.C.I.R.A.

Shuttle Relief Motion. H. Turner, Bramley, Leeds. E.P.246,341.

A slide mounted in a bracket on the lay, is connected to the breast beam by a rod and an escape spring so that it engages under a tongue on the stop rod, when the latter is actuated by the swell in the shuttle box. The end of the slide is bevelled. —B.C.I.R.A.

Griswold Knitting Machine Patterning Mechanism. W. A. Reader, Leicester. E.P.246,354.

Patterned rib fabric is produced on the Griswold machine by the use of an additional feeder and additional switch cam and an inclined pattern wheel. These parts are placed opposite the ordinary feeder and cams. Cylinder needles, selected by the pattern wheel at a point where the dial needles are retracted, are raised at the proper time to take yarn from the additional feeder and are then moved down by the additional switch cam which is adjustable vertically. The wheel is carried by a slotted bracket so that it may be withdrawn from action. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Knitting—

245,192. A. G. Brown. Machine for making ornamental zig-zag stitching.
245,384. G. M. G. Makin. Self-threading carriage.
246,113. R. W. Scott. Device for heel and toe knitting for socks.
246,225. Bentley Engineering Co. Splicing mechanism for circular machines.

Fabrics—

245,621. J. R. Kendrick Co., Inc. Elastic fabric: edging process.
246,190. J. W. Sunderland. Wire fabric weaving process.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming

Knitted Cotton Fabric: Scouring and Wetting-out. H. C. Roberts.* *Amer. Dyestuff Reporter*, 1925, **14**, 781-783.

A general article on the removal of impurities from knitted cotton fabrics intended for dyeing or rubberising and on the use of hydrogenated hydrocarbons such as Tetralin and Isomerpin for wetting-out prior to dyeing. —B.C.I.R.A.

Wetting-out Agents: Lanadin and Hydraphthal. *Text. Colorist*, 1926, **48**, 251.

Lanadin is an alcoholic soap solution containing 87% of trichloroethylene and hydraphthal contains 90% of tetralin, 3·3% of water, and 5% of ammonium oleate. Both products are now being marketed as assistants in the wet treatment of textile materials. —A.J.H.

Excessive Loss of Weight when Degumming with Hard Water. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 12, p. 44.

Experiments showed that silk boiled-off in soft water lost 27·7%, while similar material in hard water lost 32·1%. Soda-ash is added to hard water and has a tendency to dissolve the fibroin, to deaden the lustre, and to give a yellow tone. There is danger also of depositing insoluble calcium and magnesium soaps on the fibre, which give rise to endless troubles in dyeing. When Turkey Red oil is added to assist degumming in hard water there is risk of bad rinsing; then dark blotches of coagulated oil show up in an acid dyebath. —F.G.P.

Method for Boiling-off Georgette Crêpe. *Text. Colorist*, 1925, **47**, 810.

The goods are run in rope form without tension and plaited down into a wooden tank, afterwards being covered with a solution of olive oil soap or red oil soap. Having been clamped down with a wooden perforated cover, the bath is raised to the boil by live steam under a false bottom. When boiled off the goods are washed free from soap and, if necessary, bleached in hydrogen peroxide. —F.G.P.

The Boiling-off of Silk. M. N. Conklin. *Color Trade Jl.*, 1924, **15**, 143.

Silk is stronger than steel wire; it is coated with a glue-like substance which must be removed before the lustre and softness are brought to perfection. The amount of sericin varies from 8-14% on Tussah to 20-24% on Tsatlees. The usual method of removing sericin is to work in 30% (on weight of silk) of good neutral olive oil soap just below the boil for 1-2 hours. Tangling must be avoided. Sometimes two boiling-off baths are used, the second becoming the first for the succeeding batch. The first is known as boiled-off liquor and is

used when dyeing "artificial" colours, as it is claimed to make them brighter and clearer. The Schmid foam method of degumming is mentioned; the hanks are hung on rotating poles in the foam of a boiling soap bath. —F.G.P.

(G)—BLEACHING

Cotton and Artificial Silk: Bleaching. T. D. Ainslie. *Text. World*, 1925, **68**, 3551-3553.

The advantages of bleaching cotton and artificial silk by the peroxide method are discussed. —B.C.I.R.A.

Present Situation in Peroxide Bleaching. *Text. Colorist*, 1925, **47**, 635.

It is stated that the only peroxide bleach to be considered is sodium peroxide; liquid peroxide is confined to silk and particularly to small bleachers. The sodium peroxide is more economical in transportation and is of 140 volume strength compared with liquids of 10 to 100 volume, which are carried in casks or bottles. Silks, woollens, and worsteds are whitened in peroxide, which has no unpleasant odour and gives the fabric a good feel; the white does not degrade on storing. Unions are better bleached in peroxide, as chlorine has ill effects on animal fibres. In America the cotton knitting trade is beginning to replace chlorine with peroxide, as it reduces tendered goods and seconds, and saves labour, steam, and water, whereby the higher cost of bleaching agent is neutralised. The invention of suitable apparatus is needed in the cotton piece goods bleaching trade, whereby the boil and bleach may be done in one bath, thus cutting out numerous handlings and rinsings. —F.G.P.

Silicate Bleaching Agents: Application. J. D. Carter. *J. Ind. Eng. Chem.*, 1926, **18**, 248-252.

The use of soluble silicates increases the efficacy of the hypochlorite bleach. With a saving in chlorine, a whiter product is obtained, there is a gain in strength of the fabric and the ash content is raised more rapidly owing to the deposition of hydrous silica. The addition of sodium silicate in bleaching wood pulp with calcium hypochlorite effects marked improvement in the product and facilitates the bleaching of refractory pulps. —B.C.I.R.A.

Bleaching Powder: Manufacture. D. F. Richardson, W. E. Emley, and J. M. Porter. *Chem. Met. Eng.*, 1925, **32**, 936-937.

In order to produce a satisfactory bleaching powder for commercial use, the amount of water used in hydrating the quicklime should be controlled. According to the experiments described it should be between $32\frac{1}{2}$ and 55% based on the weight of quicklime used. The most satisfactory product was obtained when using between 45 and 50% in which case the lime was almost completely hydrated, little or no free water being present. —B.C.I.R.A.

Bleaching. American Association of Textile Chemists and Colorists. *Amer. Dyestuff Reporter*, 1925, **14**, 832-834.

The value of bleaching assistants in the kier boil is discussed, but opinions are conflicting. It is stated that in the combination bleach the addition of bleaching assistants considerably retards the action of the peroxide bleach, thereby resulting in a more uniform bleaching. —B.C.I.R.A.

Towellings; Bleaching and Dyeing of——. I. Ginsberg. *Chem. Absts.*, 1926, **20**, 292 (from *Text. Colorist*, 1925, **47**, 701-702).

Fast colour towellings should be dyed only with vat dyes, about 33% excess of hyposulphite being used. Naphthol AS may be used for red. It is claimed that a previous treatment of the fabric with a 2 or 3% solution of acetic acid prevents the usual bleeding of reds on bleaching. Sulphur blacks are also used. Indanthrene Blue and Alizarin Cyanol EF or B are recommended for blueing. —L.I.R.A.

Sized Fabrics; Bleaching of——. I. Ginsberg. *Chem. Absts.*, 1926, **20**, 827 (from *Text. Colorist*, 1925, **47**, 777-779).

Work is reviewed which indicates that chlorine will combine with starch to form a substance insoluble in water. In this way fabrics containing a residue of starch size may take up chlorine during bleaching. When this chlorine product is decomposed, the chlorine may cause a deterioration of the cotton. —L.I.R.A.

Bleaching Cotton Cloth with Hypochlorites. R. Sansome. *Text. World*, 1926, **69**, 71-73.

Plant for obtaining hypochlorite solutions from liquid chlorine is described. —A.J.H.

(I)—DYEING

Cross Dyeing of Celanese Yarn with various other Fibres. R. G. Dort. *Chemicals* (Dyestuffs), 1926, **25**, 22-26 and 39.

A third article describing the cross-dyeing of materials containing Celanese in conjunction with other fibres. Lists of Celanese-resist colours for cotton, wool, and silk are given. Celanese-cotton or Celanese-rayon mixed goods can be cross dyed in one bath in any brilliant contrasting shades desired. Two fibre combinations of Celanese and wool or Celanese and silk are best cross dyed by the use of two separate baths. Recipes for solid and contrasting shades on mixed materials containing Celanese are given. Three-colour combinations may be obtained if desired. —L.I.R.A.

Logwood: Application. E. Lesser. *Amer. Dyestuff Reporter*, 1925, **14**, 755-763.

A general account of the preparation of logwood extracts and its application in dyeing. —B.C.I.R.A.

Cellulose Acetate Silk: Dyeing. H. R. Davies. *Amer. Dyestuff Reporter*, 1925, **14**, 887-890.

A general discussion of some recent developments in the dyeing of cellulose acetate silk. —B.C.I.R.A.

Artificial Silk: Vat Dyeing. F. F. Warshaw. *Amer. Dyestuff Reporter*, 1926, **15**, 3-6.

A general account of the process of dyeing artificial silk with vat colours. —B.C.I.R.A.

Naphthol Colours: Application. H. E. Hager and W. R. Marsson. *Amer. Dyestuff Reporter*, 1926, **15**, 6-12.

After briefly tracing the development of the Naphthol AS series the author describes how the Naphthols can be very successfully mixed with Indanthrene colours to give shades of equal fastness and brightness at greatly reduced costs. The Naphthols can also be combined with sulphur colours, providing shades which could not be produced with sulphur colours alone. The cost is not very materially increased and the fastness is considerably improved. Such combinations can be made for delicate shades, but the economic advantages are less and it is concluded that the Naphthols should be confined to medium and heavy shades of which particular fastness is required and where the cost of Indanthrenes is prohibitive. Light tones, with the exception of pinks, should preferably be dyed with Indanthrene alone. —B.C.I.R.A.

Viscose Mordant: Application. W. C. Durfee. *Amer. Dyestuff Reporter*, 1926, **15**, 22-23.

The application of mordant dyes to viscose silk is discussed. A chromium mordant, at present known as "viscose mordant" has been prepared. The viscose was mordanted at 60° C. for about 40 minutes and well rinsed. It was dyed soon afterwards at about 80° C. for about 1¼ hours. The mordant is applicable to several types of artificial silk, but does not act on cellulose acetate silk. The author refers to the evenness with which cotton and viscose could be dyed together in the same bath to a uniform shade. —B.C.I.R.A.

Vat Dyes: Application. M. E. Tice. *Amer. Dyestuff Reporter*, 1926, **15**, 49-51.

Directions are given for three methods of applying vat colours to cotton piece goods to obtain light, medium, and heavy shades. With heavy shades it is the author's practice to mercerise after dyeing, as this makes the dye fast to rubbing and improves the shade. —B.C.I.R.A.

Vat Dyes: Discharging. J. Kern. *Amer. Dyestuff Reporter*, 1926, **15**, 52-56.

The paper deals with the properties of vat dyes in relation to discharging. Dyes of the indigo, anthraquinone, and sulphur classes are considered and their reduction by certain hydrosulphite discharge pastes is discussed. —B.C.I.R.A.

Artificial Silk: Dyeing. L. A. Olney. *Amer. Dyestuff Reporter*, 1926, **15**, 109-114.

A comprehensive general article on the dyeing of artificial silks, alone and in admixture with other fibres. —B.C.I.R.A.

Liquefaction of Silk on Dyeing. *Silk* (N.Y.), 1925, **18**, No. 11, p. 41.

Silk which has been treated roughly in dyeing is stated, as "a well-known fact," to become liquid and so set loose some of the very finest fibres. As it also occurs when the silk is not roughly handled, the fault must lie with the silk. The differences in the behaviour of silk are due to the health of the worms, the nature of their food, and other factors, such as weather. It is, therefore, evident that very much of the success in producing good silk depends upon physiological conditions at the time of spinning the cocoons. —F.G.P.

Pyrolignite of Iron. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 11, p. 44.

The commercial liquid is used in conjunction with tans for dyeing silk black: when it is used with acetate of lead silk can be weighted up to 350%. It is used also in other processes when a blue black is required. The black iron liquor is produced by treating scrap iron with commercial acetic acid and is generally of 1·150 sp. gr. (30° Tw.). It is sometimes made by decomposing ferrous sulphate with crude calcium acetate. The liquor contains mainly ferrous acetate with some of the ferric salt; traces of tarry matter are thought to prevent oxidation. The addition of pyrocatechin also serves this purpose, as does the derivative guaiacol. —F.G.P.

Spring Color Card, 1926. *Silk* (N.Y.), 1925, **18**, No. 11, p. 36.

The Textile Color Card Association has several new shades of Bois de Rose, Rose Beige, and Old Wine Red, and of Violet and Grey-Blues. Among the yellowish-greens are Chartreuse and Absinthe. Coral, Salmon, and Rose are back, and some new tones are shown in Russian Violet and Orchid shades. Burnt Almond and Honey are present in several gradations. —F.G.P.

Colouring and Sizing of Ribbons. I. Ginsberg. *Text. Colorist*, 1925, **47**, 571.

Ribbons are woven of silk, rayon and mixtures with cotton. They are rarely dyed in the yarn. When cotton is used they are singed before degumming. Very light silk ribbons are weighted with tin. Practically all kinds of dyes are used. Ribbons are sized to give them proper feel and appearance; all kinds of materials are used for this purpose. The sizing bath

needs to be perfectly clear in order to avoid spoiling the lustre and colour. The sized ribbons are dried over cylinders and calendered. —F.G.P.

Machine for Dyeing Hosiery in which the Dye Liquor is Circulated. *Text. Colorist*, 1925, **47**, 580.

In this machine, it is stated, that chiffon stockings can be worked for 24 hours without injury. The vat is rectangular and divided into two chambers by a perforated wall. Below a perforated false bottom is a shaft with a propeller in the centre. This works in both directions, driven by a motor. The bottom is curved to allow even flow of the liquor.. Steam is brought in under the floor of each chamber alternately, as the direction of the liquor flow is changed. Half the batch is put in each compartment and the bags rise and fall in accordance with the steam entry. This prevents channelling, and is the only motion imparted to the goods. —F.G.P.

Four Aluminium Mordants for Silk. *Text. Colorist*, 1925, **47**, 584.

Salts of aluminium need to be neutralised with carbonate of soda until the white flocculent precipitate formed on addition just ceases to be redissolved. For 10 lb. of alum crystals about 2½ lb. of soda crystals are required. Aluminum salts should be free from iron. The quantity of aluminium may vary between 1% and 15% of the silk weight and the time from 8 hours to 6 hours, depending on the depth of shade required. The temperature of the bath may vary apparently between cold and 122° F. A cold bath of soda or bicarbonate follows. The goods are then thoroughly washed, and given a cold bath of soap or sodium silicate for 15 minutes. These general directions apply more especially to alum and aluminium sulphate. Aluminium acetate may be used, cold, for 3-5 hours, the goods being raised and left to drain before washing in soda. A little addition of 1-5% tin salt may be used for brightening scarlets. The aluminium nitro-acetate bath is prepared by dissolving separately aluminium sulphate: 210 parts; calcium acetate: 55·5 parts; calcium nitrate: 135 parts, and then mixing them. A few drops of potass. ferrocyanide are added to precipitate any traces of iron in the mixture and after standing, a few drops of stannic chloride. No details of quantity of water required or necessity for filtering are given. —F.G.P.

Dyeing Silk-cotton Mixtures. *Text. Colorist*, 1925, **47**, 647.

In dyeing such mixtures sulphuric acid may not be used in direct dyebaths because of its action on the cotton, and soda because of its action on the silk. Soft water is necessary and may be obtained by boiling with soda. Heat should be applied through an unperforated steam coil. Soap is sometimes used to assist in getting level shades. Fabric is assumed to be thoroughly dampened before it is entered into the boiling dye vat. It is recommended that dyes which are known to have little affinity for silk should not be used. This article has been specially contributed and contains two pages of information similar to that given above. —F.G.P.

Dyeing Tin Weighted Silk. *Text. Colorist*, 1925, **47**, 651.

It is stated to be quite customary to do tin-weighting of silk separately from dyeing. Some of the acid dyes are said to be resisted by the tin salt in silk. It is necessary that the weighting be even or unevenness of dyeing may result. Basic dyes have good affinity for weighted silk, but it is advisable to wash the silk after weighting in order to remove excess of metallic salt not absorbed by the fibre. Weighted silk which has been stored for a considerable time may dye up unevenly. In America, manufacturers find that reddish spots sometimes develop on weighted silk; these spots become tender. This effect may be cured by padding in a bath of sulpho cyanide or hydrofluoric acid. —F.G.P.

Dyeing Cotton-silk Mixtures Black. *Text. Colorist*, 1925, **47**, 719.

It appears to be difficult to dye these mixtures a level black. An old method still in favour is to mordant in a bath containing cutch, copper sulphate, and ferrous sulphate for 2 hours at 122° F. Then dye in a bath of logwood, fustic, and 15% soap. For a blue-black the process given is—(*a*) immerse cold in a bath of 10% indigo substitute, 5% indigo extract, 2½% alum, and raise the temperature slowly to 140° F., keeping it so for 30 minutes; (*b*) add 5% sodium carbonate and work for 30 minutes; (*c*) rinse and work in cutch 30%, copper sulphate 2%, at 100° F. for 1 hour; (*d*) allow slowly to cool for some hours and work in iron pyrolignite at 4° B. at no given temperature for no specified time; (*e*) rinse and return to the cutch bath for 1 hour; (*f*) dye in a liquor containing logwood, fustic, and 15% soap. —F.G.P.

Aniline Blacks on Mixtures of Silk and Cotton. *Text. Colorist*, 1925, **47**, 723.

The following is stated to be the only successful method. A solution of aniline hydrochloride 1,000 pts., ammonium chloride 250 pts., hot water 4,000 pts., is cooled and mixed with copper sulphate 130 pts., sodium chlorate 400 pts., water 4,000 pts., when cold. This is then mixed with a cooled solution of wheat starch 100 pts., dextrine 100 pts., sodium acetate 3 pts. in water 5,000 pts. Just before use the following is added—Ammonium vanadate 0·5 pt., water 60 pts. The fabric is padded through this bath two or three times, and dried at 86°-104° F., before hanging in a moist chamber for 12 hours to oxidise. The goods are then worked

in a weak bath of soda and passed to the oxidation bath—potassium chromate 3%, sulphuric acid 0·5%, for 15 minutes at 122°-140° F. After washing, a final soaping is given at 140°-158° F. If necessary, the colour may be shaded with logwood or Methylene Blue. A variant given is the use of copper sulphide paste or copper sulphocyanide. —F.G.P.

Mordant Reds for Silk. H. W. Wilson. *Text. Colorist*, 1925, **47**, 734.

Mordanting silk is said to spoil the lustre, feel, and elasticity. Alizarine Red and Alizarine Bordeaux may be dyed on silk mordanted with aluminium, chromium, or iron. Hard water containing lime is required with Alizarine Red. These reds on aluminium are stated to be fast to light but not to soap and alkali; but Alizarine Bordeaux on chromium is fast to all. —F.G.P.

Dyeing of Rayon. *Text. Colorist*, 1925, **47**, 792.

Beam, cop, and cheese dyeing is said to be unsatisfactory. It is stated that rayon is not injured if dyed just below the boil or actually boiling in mixtures with cotton for hosiery, but the general practice is to use a low temperature. Especially with the cheaper sorts of viscose, unevenness of shade necessitates sorting into lots. Basic dyeing on tannin and antimony is thought to spoil the rayon through protracted working. Mordanting with Katanol gives better results. Sulphur dyes are not good for rayon, though sometimes they are employed on warps. Vat dyes, too, are very severe and the process should be hurried as much as possible. Level dyeing in these cases is very difficult. —F.G.P.

Skein Dyeing of Rayon. *Text. Colorist*, 1925, **47**, 793.

The "Heathen Chinee" is said to have a rival in the rayon skein dyer; 90% of the complaints about skein dyed rayon come from the winders. Wet rayon is very slimy and slippery; the tie bands shift and a tangled skein results; movement during dyeing should be reduced to a minimum to avoid this. Live steam admitted to the bath would tangle the skeins badly. The time of all processes should be cut to a bare necessity. Machines in which the skeins are suspended on two rotating sticks are stated to give good results. The dyeing is carefully timed and thus the lagging of the dyers in the afternoon to avoid starting a fresh batch is prevented. Damage by unskilled handling is also reduced, and it is said the labour cost is cut by 50-80%. Winders are believed to prefer machine to hand-dyed rayon skeins. —F.G.P.

Dyeing Mixtures of Cotton and Silk to Produce Two-colour Effects. *Text. Colorist*, 1925, **47**, 794.

One method recommended is to dye the silk first and, after washing, to mordant the cotton with tannin and antimony and dye it with a basic colour in the cold, to avoid shading the silk. Direct dyes may be used for the cotton. The cotton may be dyed first and the silk with acid dyes in a lukewarm bath. Not all acid dyes are suitable. Some of the diazo colours produce little effect on silk. Sulphide dyes may be kept off the silk if casein is added to the bath. —F.G.P.

Dyeing Wool with Indigo. *Text. Colorist*, 1926, **48**, 108-109.

The application of indigo to wool from a hydrosulphite vat is described. —A.J.H.

Improving the Fastness of Cotton Dyeings. *Text. Colorist*, 1926, **48**, 110.

Primuline dyeings are treated with a warm dilute solution of bleaching powder for the production of fast reddish shades. Dyeings obtained by means of direct cotton dyestuffs are made fast to washing by treatment with solutions containing ½% of aluminium sulphate and ½% of sodium acetate or ¼% of sodium carbonate (anhydrous), or by successive treatments with dilute solutions containing magnesium sulphate and caustic soda. Shades obtained by topping direct dyestuffs with basic dyes are faster if the first dyeing with the direct dyestuffs is carried out in the presence of tannic acid and the resulting dyed fabric fixed with tartar emetic before topping. —A.J.H.

Dyeing Machine for Loose Fibres. *Text. Colorist*, 1926, **48**, 114-115.

A description of the Franklin raw stock dyeing machines capable of treating 250, 500,or 1,000 lb. of materials. —A.J.H.

Dyeing of Natural Silk Fabrics. R. Sansome. *Text. Colorist*, 1926, **48**, 165-167.

Some notes on the dyeing of silk fabrics with acid, basic, and direct dyestuffs. —A.J.H.

Commercial Dyes and Pigments: Classification. C. E. Mullin. *Text. Colorist*, 1926, **48**, 167-170.

A list of dyestuffs classified with regard to their commercial group names, class, and manufacturers. —A.J.H.

Colour and Colour Theory [Dyestuffs]. A. P. Sachs. *Text. Colorist*, 1926, **48**, 171-173.

A continuation of previous articles dealing with colour harmony. —A.J.H.

Resorcine Dyes for Cotton, Wool, and Silk. *Text. Colorist*, 1926, **48**, 180-182.

A description of methods for applying Eosine and Rhodamine dyestuffs to textile fibres. —A.J.H.

Dyeing Basic Dyes on Cotton. *Text. Colorist*, 1926, **48**, 254-256.

Methods for dyeing basic dyes on cotton mordanted with tannin-iron, tannin-antimony, or Turkey Red oil. —A.J.H.

Waste Liquors from Dyeing Works; Purification of——. I. Ginsberg. *Text. Colorist*, 1926, **48**, 313-315.

A discussion, largely based on a communication of G. Ullmann (*Melliand's Textilberichte*, 1925, **6**, 346), of a method of decolorising effluents from dyeworks by their passage through a series of chambers containing sawdust. An effluent of 250,000 cubic metres may be effectively treated daily with about 150 kg. of sawdust. —A.J.H.

Portable Mixers. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 12, p. 45.

For mixing in dyebaths, Glauber salt or dye solution, a small machine is described not unlike an outboard motor for small yachts, which has a shaft with two propellers reversed, driven from a light or wall plug. It saves laborious hand mixing. Aluminium, nickel-plated brass, or monel metal are used for the shaft and blades. —F.G.P.

Metals Resistant to Corrosion in Dyehouse Equipment. C. E. Sholes. *Text. Colorist*, 1926, **48**, 264.

The resistance of copper, chrome-steel, aluminium-bronze, manganese-bronze, Monel and Mond-70 metals and nickel to alkalis, organic and inorganic acids, and oxidation is discussed. Manganese bronze is the most resistant metal to chlorine liquors, muriatic acid, and stannic chloride, and Monel metal is most suitable for general use in dyehouses. —A.J.H.

Restraining Dyes in Dyeing. C. F. Green. *Chem. Absts.*, 1926, **20**, 293 (from *Text. Colorist*, 1925, **47**, 577).

In order to obtain more even dyeings, it is suggested to work cotton yarn in a sodium carbonate solution before adding the direct dye or salt. Before dyeing tannin mordanted, or topping direct or sulphur dyed cotton with basic dyes, the goods may be worked in an acetic acid bath. —L.I.R.A.

Dyeing Sulphur Black on Cotton Piece Goods. H. C. Roberts. *Text. World*, 1926, **69**, 69-71.

A description of methods for dyeing sulphur black shades on the ordinary jig. —A.J.H.

Dyeing Cotton-warp Woollen Fabric. L. J. Matos. *Text. World*, 1926, **69**, 73-75.

Some practical details concerning methods and suitable dyestuffs for dyeing cotton-wool union fabric are given. —A.J.H.

Dyeing of Towellings. See Section 4G.

(J)—PRINTING

Preparing Wool Fabrics for Printing. *Text. Colorist*, 1926, **48**, 252-253.

A discussion chiefly directed to the chloring of woollen fabrics before printing. —A.J.H.

Copper Printing Rollers: Corrosion. American Association of Textile Chemists and Colorists. *Amer. Dyestuff Reporter*, 1925, **14**, 825-827.

A discussion on the corrosion of copper printing rollers in printing with strongly alkaline solutions of vat dyes. Three theories are considered—(1) Schawbe-Parker's theory, according to which the copper is scored by crystals of sodium chloride, sulphate, &c., which crystallise from the colour accumulated between the roller and the doctor. (2) The inclusion of grit in the printing colour from cement floors, &c. It is also suggested that sand may become attached to the cloth from the water used in the plant and in this connection it is stated that a great deal of sand accumulates with the lint on the bars at the back of a printing machine. Sand may also be present in the colour itself due to the use of unfiltered water in its preparation. (3) A theory according to which, if direct current motors are in use and there are any leaks, the printing paste acts as an electrolyte and the copper roller and steel doctor as poles so that one metal is deposited on the other. —B.C.I.R.A.

Methods of Producing Direct Printed Effects on Silk and on Rayon Silk Fabrics. R. Sansone. *Text. Colorist*, 1925, **47**, 784.

A number of formulæ of alizarine dye printing pastes is given. After the prints are dried carefully to prevent smudging they are steamed for 30 minutes at ½ at. pressure and then well washed and soaped. —F.G.P.

Drying Table for Stencil Printing. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 11, p. 44.

Stencil printing is practised by few factories and makes little progress. The table is covered with layers of material to afford the fabric a yielding bed, which is surmounted by an oil cloth to prevent absorption of the colour. This in its turn is usually faced with muslin, to which the fabric is pinned or sewn to prevent slipping. The printing is done with the aid of a box with a fabric bottom. The colour paste is spread on the inside and is forced through by means of a block. The outside of the fabric is coated with an impervious substance. Each colour requires a separate box. The first colour to be used is repeated along the fabric at alternate intervals in order to avoid blurring the edges of the wet prints, the blanks being filled in when the first prints are dry. This process is slow because of the interruptions. An improvement is adopted in some works of having the table-tops heated. Asbestos sheeting is frequently used in these cases. As well as increased output there is better definition in the pattern. —F.G.P.

(K)—Finishing

Weighting of Silk. F. K. Untiedt. *Text. Colorist*, 1926, 48, 315-318.

Abstracts of about 30 American patents relating to the weighting of natural silk are given. —A.J.H.

Method for Reducing the Amount of Weighting in Silk. *Text. Colorist*, 1925, **47**, 810.

The wet silk should be worked for a short time in a bath of 0·5% hydrofluoric acid, then wash and brighten. The amount removed depends upon the time of working. —F.G.P.

Pinking of Silk Goods. *Text. Colorist*, 1925, **47**, 801.

"Pinking" appears to mean tin weighting and it is recommended that the impregnation with tin be carried out in a centrifugal lined and coated with hard rubber. The basket should have variable gear, first to be able to run at 15 r.p.m. and after the liquor is drawn off the speed may be 1,000 r.p.m. —F.G.P.

Wool Effect on Acetyl Cellulose. *Chemicals* (Dyestuffs), 1925, **24**, 135.

Rayon of the cellulose acetate variety may be treated so as to remove the unnatural glitter of its surface and present an appearance somewhat resembling wool by working the yarn or fabric in a boiling soap bath containing 0·5% of fatty acid and 8% of acetic acid for an hour. After thorough washing the material is treated with an oil emulsion to impart softness. —F.G.P.

(L)—Waterproofing

Textile Fabrics: Waterproofing. H. P. Pearson. *Amer. Dyestuff Reporter*, 1925, **14**, 885-887.

The author emphasises the distinction between waterproof and water-resistant fabrics. A simple test which enables the two classes of fabrics to be distinguished depends on the fact that waterproofed fabrics will not allow cigarette smoke to pass through them. —B.C.I.R.A.

Textile Fabrics: Waterproofing. T. W. Wolfson. *Chemicals* (Dyestuffs), 1925, **24**, 125-127.

A general outline of available methods of waterproofing textile fabrics, including the Bonanova process and a spraying process in which the waterproofing liquid is sprayed at such a velocity that it penetrates the interstices of the fabric. —B.C.I.R.A.

Patents

Textile Materials: Conditioning. T. Allsop and W. W. Sibson. U.S.P.1,495,143 (from *Chem. Abstr.*, 1924, **18**, 2255).

Yarn or similar material is dried by heat, cooled somewhat by radiation of its heat as it passes through a cooling zone and is then subjected to the joint action of heat, moisture, and circulating air to condition it and bring it to its original weight after dyeing or bleaching. —B.C.I.R.A.

Collar Fabric: Finishing. R. F. Bacon and C. H. Kidwell. U.S.P.1,490,081. (from *Chem. Abstr.*, 1924, 18, 1915).

The zone of a collar or cuff forming the permanent line of fold is treated with a 0·5% solution of sulphuric acid or other reagent, which will produce a permanent folding tendency. —B.C.I.R.A.

Drying Machine. Tomlinson's, Ltd., and J. N. Tomlinson, Soho Works, Rochdale. E.P.245,293.

Movable carriages for supporting textile materials or other goods to be dried or treated in drying apparatus, with or without a progressive circulating system, are provided with baffles, deflectors, diffusers, or like means for projecting hot air entering at openings in the sides of a drying tunnel laterally and downwardly amongst the goods. In the case of hot air entering from the sides of the tunnel at the bottom, the baffles are inverted. A modified arrangement comprises inclined supports and spaced plates, or bent and tapering tubes may be employed. —B.C.I.R.A.

Fabric Printing Machine. E. Cadgene and G. Dupont, New Jersey, U.S.A. E.P. 245,379.

The apparatus described in the parent Specification 244,608 for printing designs on fabrics, and applying thereto, by a stencilling process, an outline in the form of a bas-relief ornamentation, is modified by connecting the printing cylinder to its shaft by a worm gear adjustment similar to the box wheel of a fabric printing machine. Also the floating stencil is driven in synchronism with the printing cylinder by being geared directly thereto by chain gearing. The printing cylinder is driven by friction from the impression cylinder and is geared by two sprocket chains to a shaft which is fitted with two sprockets connected by chains to sprockets on stub-shafts geared direct to gears on each end of the stencil drum. More than one printing roller may be employed.—B.C.I.R.A.

Differentially Sulphured Fabric: Application. Namlooze Venootschap Nederlandsche Kunstzijdefabriek, Arnhem, Holland. E.P.245,407.

Differential lustre or colour effects, or both, are produced on textile fibres, yarns, or fabrics, by treating the material so as to produce a difference in the sulphur content of the fibre. For example, a precipitate of sulphur may be produced on parts of the fibre by impregnation with an alkali metal or ammonium polysulphide and treatment with acid, or by impregnation with a solution of sulphur in an organic solvent followed by evaporation

of the solvent. Alternatively a fabric may be woven so that the weft is of unbleached viscose silk, containing sulphur, and the warp of bleached viscose silk, or a fabric which has a uniform sulphur content, such as viscose silk, may be locally desulphurised by printing with, for example, a paste containing a solvent for sulphur, or by printing with a water-repelling medium such as wax and then treating the whole fabric with the solvent. The colour effects may be obtained by treating the fibre or fabric so obtained with a dyestuff, such as "Indanthrene Rose," which produces a colour on the sulphured portion different from that on the unsulphured part, or the sulphur in the material may be converted into coloured compounds by treatment with metal compounds such as salts of copper, silver, nickel, cadmium, antimony, tin, iron, or aluminium, and into colourless metal compounds, and in either case the metal sulphide either as such or after conversion into oxide may act as a mordant for an organic dyestuff such as alizarin, and in such cases, if desired, the metal mordant may be subsequently removed. The invention may be applied to knitted or woven fabrics and the difference in sulphur content may be produced before or after making up into the fabric.

—B.C.I.R.A.

Shaped Textile Fabrics: Setting. J. M. van Heusen, Boston, U.S.A. E.P. 245,485.

Woven or knitted fabrics containing cellulosic materials, for example, for making hat shapes and boot linings, are moulded or shaped by treating them with sulphuric acid of from 70-80% concentration, washing out the acid, and drying them whilst wet on a form or in a mould, heat and pressure being applied in some instances. The invention is stated to be applicable especially to material comprising a number of thicknesses of knitted cotton fabric. The fabric may be woven or made approximately to the shape of the finished product. The material may be waterproofed by treatment with a solution of aluminium acetate followed by a strong soap bath before or after being shaped by the acid treatment. —B.C.I.R.A.

Dyestuff Emulsions; Preparation of——. C. E. J. Goedecke, Manchester, and Colloisil Colour Co., Bredbury, Stockport. E.P.245,678.

Dyestuff emulsions, suitable for use in calico printing or for lake making, are prepared by treating a dyestuff solution, which may be supersaturated or not, in a colloid mill with a substance which will form a colloidal solution or emulsion therewith, but will not form a lake with the dyestuff. Such substances are oil, fat, mineral oil, waterglass, soap, dextrin, starch, and glue, or mixtures thereof. In an example, a solution of the chloride of Brilliant Green or of Malachite Green is emulsified in a colloid mill with an equal weight of mineral oil. The emulsions may be worked up with the usual substrata, such as green earth or white earth to form dry lakes.

—B.C.I.R.A.

Dyeing Machine. W. Schmid-Koechlin, Basle, Switzerland. E.P.245,783.

During treatment with a circulating liquid such as a dye, textile materials in hank or piece form are supported on a hollow saddle of inverted U-form in cross-section, having a perforated outer surface and being connected to a pipe through which the liquid is forced by a pump. Or the support may be formed of two tubes of circular or oval cross-section, one within the other, the outer one being perforated. The area of the perforations taken together should preferably equal that of the cross-section of the pipe. —B.C.I.R.A.

Cellulose Esters and Ethers: Dyeing. I. G. Farbenindustrie A.-G., Hoechst-on-Main, Germany. E.P.245,790.

Cellulose esters and ethers are dyed with monoazo dyes containing as coupling component an *o*-aminophenol ether or a monoacyl-*m*-phenylenediamine or a homologue or substitute thereof. The dyeings may be diazotised and developed. Examples are given for obtaining a deep yellow, an orange and yellow to orange tints on cellulose acetate silk.

—B.C.I.R.A.

Alkylarylsulphonate Wetting Agents. Chemische Fabrik Milch A.-G. and K. Lindner, Berlin, Germany. E.P.246,155.

The wetting and saturation of vegetable fibres in bleaching and in the production of discharge effects is facilitated by the addition of a small proportion of an aliphatic substituted aromatic sulphonic acid, such as palmitobenzenesulphonic acid, stearotoluenesulphonic acid, or isopropylnaphthalenesulphonic acid, or of an alkali or alkaline earth salt thereof, or of a mixture of these acids or salts. Any bleaching agent may be used and in addition a monohydric or polyhydric alcohol soluble in water may be added. A preliminary kier boil is promoted by addition of the substances named to the liquor, but the kier boiling may be eliminated, or replaced by a cold treatment with dilute caustic alkali or alkali carbonate to which one of the substances has been added, with subsequent washing and scouring and then bleaching with the addition of one of the substances named. —B.C.I.R.A.

Coloured Vat Dye Discharges: Printing. I. G. Farbenindustrie, Frankfort-on-Main, Germany. E.P.246,183.

Coloured discharges are obtained upon fabrics dyed with vat dyes which are destroyed by a reducing agent, such as formaldehyde sulphoxylate, to which leucotrope W (calcium disulphonate of dimethylphenylbenzyl ammonium chloride)

is added, by printing the said fabric with a discharge containing a vat dye which sufficiently resists the action of the reducing agent. Only so much formaldehyde sulphoxylate and leucotrope should be used as will discharge the dyed ground and reduce the dyestuff in the discharge without destroying it. Dyestuffs for ground colours and for coloured discharges are specified. In each case the discharge contains leucotrope W, zinc oxide, glycerol, dissolving salt B, starch tragacanth thickening, potassium carbonate, and hydrosulphite NF, and in one case anthraquinone also. —B.C.I.R.A.

Dyeing Machine. P. Stapleton, Leicester, and E. Stroud, Quorn. E.P.246,386.

In dyeing, &c., apparatus in which the dye, &c., and the material circulate together within a vat, the vat is formed with a curved or sloping floor and the liquor is circulated by injecting into it a fluid medium such as steam or air, which causes the material to circulate in an open path wholly within the vat. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Bleaching—

246,000. United Alkali Co. Ltd. and others. Manufacture of bleaching powder.

Dyeing—

245,759. Chem. Fabr. v. Sandoz. Process for increasing affinity of animal fibres for acid dyes.

246,199. J., T., and J. Brandwood. Cop dyeing device.

5—LAUNDERING AND DRY CLEANING

Coloured Cotton Materials: Laundering. G. H. Johnson. *Cotton* (U.S.A.), 1926, **90**, 223-226.

A general account of laundry practice in the handling of dyed and printed cotton goods in power laundries. The Laundry Owners' National Association (America) has two important rules; never boil coloured goods, and never use hypochlorites with them. —B.C.I.R.A.

Hard Water: Laundering. H. B. Robbins, H. J. Macmillan, and L. W. Bosart. *J. Ind. Eng. Chem.*, 1926, **18**, 27-29.

A study of the most economical procedure in laundry practice where only hard water is available. The cost of softening water with a soap containing soda ash is practically independent of the proportion of soda ash which the soap contains. It is uneconomical to use soap alone or soap and soda ash together as a softener. For maximum economy, soda ash should first be added with agitation, allowing it a little time to react with the water before the addition of the soap. The amount of soda ash to add for waters of different degrees of hardness in order to arrive at the suds-producing point is shown. With water of zero hardness there is no practical difference in the cost of treatment whether a soap containing soda ash is used or the soda ash is added first and then the soap. —B.C.I.R.A.

Naphtha; Industrial Requirements for Dry Cleaner's——. L. E. Jackson. *J. Ind. Eng. Chem.*, 1926, **18**, 237-238.

The author discusses the advantages and disadvantages of the various solvents employed in dry cleaning, such as motor spirit (petrol), carbon tetrachloride, petroleum naphtha, benzene, and other coal distillates. The ideal solvent should be low in cost, colourless, leave no objectionable odour and the evaporation loss should be small both for economical reasons and to reduce the fire risk. At the same time it should be sufficiently volatile to be easily removed from the cloth. A well-refined petroleum naphtha boiling between 280° and 400° F. can be produced economically and is an efficient dry cleaning solvent. The specification proposed for such a petroleum naphtha is given. —L.I.R.A.

Washing Silk Fabrics. *Text. American*, 1925, **44**, No. 3, p. 12.

The American Silk Association has formed a committee under the chairmanship of Dr. W. F. Edwards to investigate the conditions of ordinary laundering of silks and to educate the public in the correct methods of procedure. The abuses of silk in washing and ironing are unreasonable and the committee has to consider the subject from many standpoints, such as—the degree of soiling, temperature of water and iron, time in washing and manipulation, concentration of soap, and number of times a piece of silk may be expected to stand washing. The committee will consult chemists, soapmakers, and laundrymen during its investigations. —F.G.P.

Patents

Washing Machine. E. Molinghen and J. Gaye, Verviers, Belgium. E.P. 245,466.

A semi-cylindrical tank is supplied with acidulating liquid flowing by gravity through a pipe from a supply tank. A partitioned cylinder rotates in the semi-cylindrical tank and the fabrics are passed to centrifugal driers, excess liquid being returned to the supply tank. A device indicating the specific gravity of the acid is provided. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Dry Cleaning—

245,306. T. Holroyd. Cleansing composition.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Cotton Duck: Testing. *Proc. Amer. Soc. Testing Materials*, 1925, **25**, i., 840-841.

Tentative specifications are issued for tolerances in width, weight, threads per inch, and strength. —B.C.I.R.A.

Cotton Yarns and Sewing Threads: Testing. *Proc. Amer. Soc. Testing Materials*, 1925, **25**, i., 831-839.

Tentative specifications are issued covering tolerances and methods of testing for counts, twists, and tensile strength. —B.C.I.R.A.

Cotton Yarn: Tensile Testing. W. F. Edwards. *Cotton* (U.S.A.), 1926, **90**, 226-230.

The possibilities of applying a serigraph test to cotton such as is used on raw silk have been investigated by comparing the results of such a test with the results of lea and single threads tests but more data are required before definite conclusions can be drawn. —B.C.I.R.A.

Cotton Yarns: Breaking Load. "H.H.Y." *Cotton* (U.S.A.), 1926, **90**, 269.

It is stated that Draper's formula, $CB = A + KC$ where B = the yarn skein break in pounds, C = the yarn count, and A and K are constants, is inconsistent since it gives negative values for the breaking load of yarns above 147's. Hyde's formula $CB^n = P$ where n is variable and P a constant, is consistent in that it does not give zero or negative values for breaking loads of fine yarns, but it gives values which are too low for coarse yarns. —B.C.I.R.A.

Dyes: Fastness to Light. R. E. Rose. *Amer. Dyestuff Reporter*, 1926, **15**, 90-91.

Seven main factors influencing fastness of dyes to light are discussed. Since these factors are all variables the author considers it impracticable to try to work out any comprehensive scheme of classification of dyes according to degree of fastness. —B.C.I.R.A.

Dyes: Fastness to Light. American Association of Textile Chemists and Colorists. *Amer. Dyestuff Reporter*, 1925, **14**, 853-855.

The following conclusions have been drawn from an investigation made with the object of devising a standard method for determining the fastness of dyes to light and in which samples of dyed materials were exposed to sunlight under various conditions. (1) Total fading varies with the angle of exposure. (2) The presence of glass over the samples considerably influences the quality of the fading. (3) The effect of free circulation of air or lack of it in exposures under glass may be considerable. (4) Continuous exposure produces somewhat different fading from exposure only whilst the sun is high and free from clouds. (5) Direct sunlight has a different effect from skylight without sun. (6) Exposures made in different localities showed little variation in the relative fading. The following tentative suggestion is made for a standard sun-fading test—Expose samples at an angle of 45°, facing due south, between 9 a.m. and 3 p.m. on sunny days in a cabinet covered with window-glass approximately ⅛ in. thick, open at the sides to allow free circulation of air. The distance between the samples and the glass should be 1 in. A portion of each sample should be protected by opaque material. In fading tests with three types of violet carbon arc it was found that the quality of the fading differed from that of sunlight and it is believed that the violet carbon arc is not a reliable substitute for the sun in fastness tests. —B.C.I.R.A.

Dyes: Fastness to Washing. American Association of Textile Chemists and Colorists. *Amer. Dyestuff Reporter*, 1925, **14**, 855-858.

The tests proposed by the German Fastness Commission and the British Wool and Silk Research Associations are criticised on the grounds of lack of precision and it is proposed to have a series of tests, instead of just two, in which the same soap solution is used but at progressively lower temperatures, or the temperature is maintained constant and the time of immersion is reduced. The dyed samples are classified according to the test in which the colour changes. —B.C.I.R.A.

Dyes: Fastness to Perspiration. American Association of Textile Chemists and Colorists. *Amer. Dyestuff Reporter*, 1925, **14**, 858.

The results of salt tests which have been made in several laboratories have not been in good agreement. Further experiments on drying the test pieces are required. —B.C.I.R.A.

Dyes: Fastness to Light. W. F. Deady. *Amer. Dyestuff Reporter*, 1925, **14**, 878-881.

The following method is proposed for establishing fastness to light standards for dyed cotton—Select ten representative cotton dyes which, when dyed in the proper percentages, will represent ten definite grades of fastness, from fugitive to very fast, when exposed to light. They must all fade to a definite end-point under exposure to the most important fading lamps as well as to sunlight. A standard yarn is spun from cotton of specified staple, scoured and dyed with the different standard dyes. The dyed yarns are woven into a striped ribbon in which the stripes pass from the most fugitive to the fastest dyed yarn. In use, the unknown sample is exposed side by side with a piece of the

standard ribbon, and when it has faded to the desired end-point its fastness is specified by counting the number of stripes of the standard which have faded.

—B.C.I.R.A.

Fading Test Apparatus. W. D. Appel. *Amer. Dyestuff Reporter*, 1925, **14**, 882-885.

In an apparatus for laboratory fading tests, the light is furnished by a large incandescent lamp which is surrounded by a 1% solution of copper sulphate contained in an inverted bell jar. The solution is circulated from the lamp to cooling coils in a second jar and back to the lamp by means of a small pump. The samples are mounted vertically on arms carried by a disc arranged below the bell jar and rotated by the motor which drives the pump. Two rows of 12 samples may be exposed simultaneously, the upper halves of the samples in the upper row and the lower halves of the samples in the lower row being covered. The samples are about 5 in. from the centre of the lamp bulb. The apparatus is enclosed in a cabinet so that the atmosphere may be controlled. Some results obtained with this apparatus are discussed and the importance of humidity in fading tests is emphasised.

—B.C.I.R.A.

Artificial Silk: Combustion Tests. *Text. World*, 1925, **68**, 2953 (from *Technical News Bulletin*).

Comparative tests at the Bureau of Standards on the four types of artificial silk and a 35's combed cotton yarn, and on samples of fabric knitted from these yarns, show that only cuprammonium silk is ignited more readily than cotton, and then the difference is very slight. Viscose silk and cotton have the same ignition point, nitro-silk is less susceptible, whilst acetate silk is the most resistant of all.

—B.C.I.R.A.

Cellulose Ester Films: Elasticity. S. E. Sheppard, E. K. Carver, and S. S. Sweet. *J. Ind. Eng. Chem.*, 1926, **18**, 76-77.

It is shown that films of cellulose esters are imperfectly elastic and flow slightly even under very small loads. The yield points, therefore, as obtained by the ordinary strength testing machines depend largely upon the speed at which the machine is run. Some load-extension curves are shown.

—B.C.I.R.A.

Artificial Silk Threads: Breaking Load and Extension. W. A. Goss. *Cotton* (U.S.A.), 1925, **90**, 119-120.

Threads of 100, 150, 200, and 300 deniers were wound into skeins of 120 yards and broken at a temperature of 70° and at 45, 55, 65, 75, and 85% humidities, the corresponding regains being 6·22, 7·16, 8·35, 9·44, and 11·19% respectively. The tests were made on a calibrated Scott tester, the distance between the rollers being 27 in. and the speed pull 12 in. per minute. The breaking loads and extensions are tabulated. The curves were found to run at an angle of 40-45° for 80% of the total break and then to turn to 90-95°, but from the turning point the thread appeared to draw out to a much finer diameter. In 98% of the tests the breaking load was lower as the humidity became higher, whilst the extension at break became greater. A decrease in breaking load with increasing humidity was similarly apparent at the turning point of the curve, but the extension was much more uniform than at the breaking point. It was also shown that the thread with the lowest extension would have no tendency to lose its diameter. It is concluded that the point at which the curve changes from 45° to 90° should be considered the best point at which to determine breaking load and extension, as from this point the diameter changes and in cloth, thread under this tension would show brilliant streaks instead of uniform colour.

—B.C.I.R.A.

Artificial Silks: Action of Alkalis and Hygroscopicity. A. K. Johnson. *Amer. Dyestuff Reporter*, 1925, **14**, 866 and 875-878.

The percentage loss of the different types of artificial silk on treatment with caustic soda has been determined. Using a 5% solution at 180-200° F. (82-93° C.) for 15 minutes, and yarns of 150 or 300 denier size, viscose showed a loss of 2·26% on the dry weight, cuprammonium silk 3·96%, and nitro silk 8·41%. The corresponding losses for Celanese and Lustron were respectively 53% and 64% and the yarns were largely reduced to a slimy mass. Hygroscopicity tests under three different humidity conditions showed marked differences in moisture and regain between the regenerated cellulose group and the acetate silks. The apparent order of decreasing hygroscopicity at reasonable humidities is nitro, cuprammonium, viscose, Celanese, and Lustron.

—B.C.I.R.A.

Methylene Blue: Application. F. W. Atack. *Amer. Dyestuff Reporter*, 1925, **14**, 766-768.

The use of Methylene Blue hydrochloride solutions in analytical chemistry is discussed and a list is given of 17 applications in which a standard solution of the dye has been used with success in the estimation of metals, acid radicles, and organic compounds.

—B.C.I.R.A.

Spraying Solutions, and Emulsions: Surface Tension. R. H. Robinson. *J. Agric. Res.*, 1925, **31**, 71-81.

An investigation of the relation between the surface tension of spraying solutions and their spreading qualities. Experimental data given include—(1) Surface tension measurements of a number of

substances in solution including soaps, mineral oil emulsions, casein, certain coal tar derivatives and essential oils, cotton seed oil, &c.; (2) measurements of the interfacial tension between paraffin oil and the same substances in solution. While no definite relationship could be established between the surface tension values of spray solutions and their observed spreading properties, the evidence is in favour of solutions having low surface tension or low interfacial tension to oil. —B.C.I.R.A.

Pectin; The Composition of——. A Preliminary Report on the Determination of Galacturonic Acid in Pectin. W. H. Dore. *J. Amer. Chem. Soc.*, 1926, **48**, 232-236.

A modification of the Lefevre-Tollens method for the estimation of uronic anhydride residues is described and figures are given for various crude pectin preparations. It is shown that by leaching crude pectin with cold 70% alcohol, about 24% of the crude substance is dissolved. By this treatment a residue of constant composition is not obtained from various crude pectin preparations, the percentages of "furfural" and of "uronic anhydride" in the residue bearing no simple relation. —L.I.R.A.

Mineral Oil-soap Emulsions: Analysis. *J. Assoc. Official Agric. Chem.*, 1926, **9**, 28-29.

Tentative methods are described for the determination of water by the xylene distillation method, total oil, soap, unsulphonated residue, and ash. —B.C.I.R.A.

Fat Solvents. C. E. Bills. *J. Biol. Chem.*, 1926, **67**, 279-285.

The solubility of fats in some 250 organic solvents of all types was investigated. A table of solvents immiscible with the five fats selected is given; a second table is a list of solvents miscible with cod liver oil, with notes on their colour reactions and chemical behaviour. —B.C.I.R.A.

The Inactivation of Trypsin by X-rays. H. Clark and J. H. Northrup. *J. Gen. Physiol.*, 1925, **9**, 87-96.

The inactivation by X-rays runs parallel with spontaneous heat inactivation and follows the simple exponential law that indicates a monomolecular reaction. The nature of the process of inactivation is discussed; inactivation seems to result from electrical neutralisation of the trypsin ion. —E.A.F.

Some Consequences of the Theory of Membrane Equilibrium. D. I. Hitchcock. *J. Gen. Physiol.*, 1925, **9**, 97-109.

In applying Donnan's theory of membrane equilibria to systems where the non-diffusible ion is furnished by a weak acid, base, or ampholyte, certain new relations have been derived. Equations have been deduced which give the ion ratio and apparent osmotic pressure as functions of the concentration and ionisation constant of the weak electrolyte, and of the hydrogen ion concentration in its solution. The conditions for maximum values of these two properties have been formulated. The progressive addition of acid to a system containing a non-diffusible weak base should not cause the value of the membrane potential to rise, pass through a maximum, and fall, but should only cause it to diminish. The theory predicts slight differences in the effects of salts on the ion ratio in such systems, the effect increasing with the valency of the cation. —E.A.F.

On Some General Properties of Proteins. M. L. Anson and A. E. Mirsky. *J Gen. Physiol.*, 1925, **9**, 169-179.

The processes of denaturation and coagulation are probably similar for all proteins. Denaturation is a process of depolymerisation; conversely native proteins can be regarded as aggregates of denatured proteins. The globins and histones are to be regarded as denatured proteins rather than as a distinct group of proteins. The factors affecting the equilibrium between native and denatured proteins are discussed. A non-polar group is uncovered when a protein is denatured. It is shown that judged by the two most sensitive tests for the specificity of proteins, it is only when proteins are in the native form that they are highly specific. —E.A.F.

The Effect of Radioactive Radiations and X-rays on Enzymes. IV. The Effects of Radiations from Radium Emanations on Solutions of Invertase. R. G. Hussey and W. R. Thompson. *J. Gen. Physiol.*, 1925, **9**, 211-215.

The inactivation of invertase by β-radiation is similar to that of trypsin and pepsin. The rate of change in the logarithms of the concentration of the active enzyme with respect to the variable, W, is constant when the volume of solution exposed is constant. When the volume, V, is varied the rate of inactivation is inversely proportional to V, i.e., $-\frac{d \log Q}{dW} = k = \frac{K}{V}$ —E.A.F.

The Effect of Radiations from a Mercury Arc in Quartz on Enzymes. I. The Effect of Ultra-violet Radiations on Pepsin in Solution. R. G. Hussey and W. R. Thompson. *J. Gen. Physiol.*, 1925, **9**, 217-219.

Pepsin in solution is inactivated by radiation from a mercury arc in quartz. The form of the curve describing the course of the inactivation is that of monomolecular chemical change. —E.A.F.

The Effect of Radioactive Radiations and X-rays on Enzymes. V. The Influence of Variation of the Thickness of the Absorbing Layer of Solutions of Pepsin upon the Rate of Radiochemical Inactivation of the Enzyme. R. G. Hussey and W. R. Thompson. *J. Gen. Physiol.*, 1926, **9**, 309-313. —E.A.F.

The Effect of Radioactive Radiations and X-rays on Enzymes. VI. The Influence of Variation of Temperature upon the Rate of Radiochemical Inactivation of Solutions of Pepsin by Beta Radiation. R. G. Hussey and W. R. Thompson. *J. Gen. Physiol.*, 1926, **9**, 315-317.

The effect of temperature is very slight. —E.A.F.

The Dissociation Constants of Racemic Proline and Certain Related Compounds. C. M. McCay and C. L. A. Schmidt. *J. Gen. Physiol.*, 1926, **9**, 333-339.

The breaking of the pyrrolidine ring of proline by nitrous acid is not a factor of sufficient magnitude to account for the amino nitrogen which is usually found in proline preparations. A method for preparing racemic proline is described. The product is found to be free from amino-nitrogen. The dissociation constants of racemic proline and of some related compounds were determined. —E.A.F.

The Combination of Salts and Proteins. II. A Method for the Determination of the Concentration of Combined Ions from Membrane Potential Measurement. J. H. Northup and M. Kunitz. *J. Gen. Physiol.*, 1926, **9**, 351-360.

A method is described for measuring membrane potentials of gelatin salt solutions, and it is pointed out that such measurements together with the analysis of the solutions, allow the calculation of the concentration of ions combined with the protein. The values for the combined ions obtained in this way for $ZnCl_2$, KCl, LiCl, and HCl agree quite well with those obtained by direct concentration cell measurements. —E.A.F.

Lime: Rate of Solution. R. T. Haslam, F. W. Adams, and R. H. Kean. *J. Ind. Eng. Chem.*, 1926, **18**, 19-23.

The rate of solution of a commercial lime, and hence its availability, depends on the fineness of the lime and is directly proportional to the area and to the ultimate solubility of the lime. If the lime reacts with an acid solution forming a soluble lime salt, the rate of solution is increased, the increase being directly proportional to the concentration of the acid. In the presence of excess acid forming an insoluble salt, the particles of lime become encrusted with the insoluble coating so that the rate of solution is decreased. When the lime reacts with a salt with the production of an insoluble salt, the rate of solution is still further decreased. An availability test must, therefore, in order to be of any value, be based on the particular process in which the lime is to be used. —B.C I.R.A.

Calcium Arsenate: Toxicity. S. B. Hendricks, A. M. Bacot, and H. C. Young. *J. Ind. Eng. Chem.*, 1926, **18**, 50-51.

A study of the relative toxicity of the calcium arsenates shows that in relation to the boll weevil the basic arsenates have a constant toxicity, but the acid arsenates are much more toxic. —B.C.I.R.A.

Jelly Strength of Pectin Gels. G. L. Baker. *J. Ind. Eng. Chem.*, 1926, **18**, 89-93.

An apparatus for testing the strength (i.e., resistance of jellies to pressure) is described. A uniformly increasing pressure is gradually applied to the jelly surface by a plunger till the plunger just breaks through the surface. To determine any effect on the result which formation of skin may produce the jelly is turned out of the glass container and reversed so that what was previously the under surface is now subjected to pressure. The pressure is developed by water displacement of air in a large Woulfe bottle and communicated to a syringe chamber connected with a monometer. The surface of the thumb piece of the syringe rests on the jelly. In the author's experiments with pectin jellies the pressure was always regulated so that the pressure increase per minute applied was always the same when the plunger rested against an unyielding substance. Curves for pectin strengths are given. A description of the preparation of the gels is given and the various factors influencing jelly strength are discussed, such as—Acidity, varying concentrations of sugar and pectin in the jelly, time and temperature of preparation and effect of ageing. —L.I.R.A.

Lime: Hydration. W. G. Whitman and G. H. B. Davis. *J. Ind. Eng. Chem.*, 1926, **18**, 118-120.

A study of the effect of various hydration methods on the properties of hydrated lime is described. The quality of the hydrated product was estimated by determining its rate of reaction with *N* hydrochloric acid, its rate of settling in water and by microscopic examination. High-grade hydrate contains many fine particles which are produced when the rate of hydration is rapid compared with the rate of growth of the particles. Excess water, reasonably high temperatures and agitation all favour rapid hydration and a fine product. Excessively high temperatures, generated locally in the lime from the heat of reaction, are very detrimental because the lime approaches its "dehydrating" temperature whilst still only partially hydrated. Completion of the reaction is then very slow and during this time the particles grow in size and the final product is very coarse. The best product is prepared by hydrating quicklime with a large excess of water in boiling solution. Hydration with the theoretical amount of water or with water vapour gives a coarse inferior hydrate. —B.C.I.R.A.

Ozone: Estimation. H. B. McDonnell. *J. Ind. Eng. Chem.*, 1926, **18**, 135.

Ozonised air is delivered by a tube of definite dimensions into a solution containing sodium thiosulphate, starch, and

potassium iodide, and the time required for the appearance of the blue colour is noted with a stop-watch. The concentration of ozone varies inversely with the time. The method is applicable to low concentrations where the amount of ozone used in the test is not over 1 mg. For higher concentrations the potassium hydroxide liberated causes low results, but it is suggested that the addition of a little boric acid to the thiosulphate-potassium iodide solution would adapt the method to higher concentrations. The method can also be used for dilute mixtures of chlorine and air. —B.C.I.R.A.

Adhesives; Films of——. J. W. McBain, and D. G. Hopkins. *J. Phys. Chem.*, 1926, **30**, 114-125.

The authors consider two types of joints which they designate specific and mechanical. For both types the tensile strength of the film of adhesive used sets an upper limit to the strength of the joint obtainable, since it is the film which transmits the strain. The method of testing the tensile strength as carried out by the authors by dipping strips of filter paper in the liquid adhesive was found to be unsatisfactory owing to (1) the unknown nature of influence of paper on the structure and fracture of the film, (2) the strength of the paper being relatively great, as compared with the film strength. A rapid and simple method of working with thin films is suggested. Very thin films are formed by drying the liquid adhesive on a surface to which it does not adhere, these are cut into test pieces in the ordinary way, the ends being reinforced by strong paper for holding in the grips of the testing machine. Prevention of air bubbles in the films is a necessary precaution, so that a whirling motion is used to mix the solution during preparation. The authors worked mainly with glue and gelatine solutions with or without added substances. Generally the relative humidity to which the films are exposed must be taken into account. Glue and gelatine films each showed a tensile strength of approximately five tons per square inch. Another observer using a similar method of preparation found starch films to have a tensile strength of $2\frac{1}{2}$ to $4\frac{1}{2}$ tons per square inch. The authors state that the experimental error involved in this method of determining tensile strengths of films is generally much less than 10%. —L.I.R.A.

Viscosity of Colloidal Solutions and a Theory of Neutral Colloids as Solvated Micelles capable of Aggregation; The Apparent——. J. W. McBain. *J. Phys. Chem.*, 1926, **30**, 239-247.

The author brings forward a hypothesis regarding the viscosity relations of colloidal solutions, their changes with time and temperature, the structure and reversible changes of jellies, ascribing the chief role to "solvation," which is thought to be more important than the electrical charge effects. Mechanical explanations of the high viscosity of colloidal solutions, suspensions, &c., as compared with that of the solvent, are given. The chief source of viscosity being ramifying aggregates in the solution, the best solvent is that which disintegrates these, so that the highest viscosity increases do not reflect "solvation," but the contrary, i.e., insufficient "solvation" to disintegrate the particles. As regards neutral colloids and their stability, the author suggests that with a good solvent the micelle aggregates, which are linked by valencies, are broken up, the separate micelles, thus formed, having free valencies, unite under suitable electrico-chemical conditions with a portion of the solvent. According to the author's theory the formation of a jelly from a sol does not imply any extensive alteration in the solution structure—it is only necessary to break the bond between the micelles and solvent at a few points when loose joining of adjacent micelles occurs and a jelly structure results. The author considers the presence of elasticity in a colloid solution to be a positive test for the presence of ramifying aggregates.

—L.I.R.A.

Glue: Viscosity and Jelly Strength. W. L. Jones. *Mech. Eng.*, 1925, **47**, 1072-1074.

The standard methods adopted by the National Association of Glue Manufacturers (U.S.A.) are briefly described. In criticism of the viscosity determination the author points out that the moisture content of the sample is not taken into account. A detailed drawing of the Bloom gelometer is given. —B.C.I.R.A.

Knitted Fabric: Testing. *Proc. Amer. Soc. Testing Materials*, 1925, **25**, i., 842-846.

Tentative specifications are issued for tolerances and methods of testing regain, grease, percentage of cotton and wool, width, weight, thickness, wales and courses, and strength. —B.C.I.R.A.

Prevention of Damages in Textile Fabrics. J. Chittick. *Text. American*, 1925, **44**, No. 3, p. 11.

"Shifts" in silk goods are slippings of the warp or weft in such a way that an irregularity is produced. These are very noticeable in crêpe de chines, satin crêpes, &c. Heavy fingering in the loom or on the stenter is liable to produce them, and they may be caused by undue handling in the dyebath. When satin-faced goods are double-folded and blocked there is sometimes a tendency for the operator to produce slips by pulling the material into line. This may be corrected by careful stentering. Fabrics which are loosely bound are particularly liable to this defect and all workers should be especially cautioned to handle delicately. —F.G.P.

Hosiery Association attacks "Seconds" Evil. *Text. American*, 1925, **44**, No. 5, p. 68.

The National Association of Hosiery and Underwear Manufacturers of America has requested all its members plainly to mark both stockings in a pair with some such brand as "Seconds," "Imperfect," "Second Quality," &c. This has been done because of the increase of small shops which specialise in selling such goods as first quality at prices which honest retailers cannot touch. They sort out the unmarked stockings and make them up in pairs. Most of the "astounding values" in silk and rayon stockings are due to deliberate misrepresentation of seconds as firsts. —F.G.P.

Silk and its Testing. J. O. Thompson. *Text. Colorist*, 1925, **47**, 712.

Strength is very important in silk, which is stronger than other textiles because it is made of long lengths of continuous fibres, whereas the others are merely short fibres twisted together and liable to slip apart. The strength of silk is roughly the average denier multiplied by 4 and expressed in grammes. Less than this is weak. The capacity for elongation in silk, greater when damp than when dry, is useful to the throwster because it does not snap immediately there is a catch, and to the weaver because when a coarse thread reaches the reed it may stretch sufficiently to pass through without breaking. It is stated that raw silk containing 12-14% humidity is 15-25% more ductile than that containing 8%, and its permanent elongation is 4% more. This effect of moisture is considered to be due to the glue-like nature of the serecin. —F.G.P.

Rule for Diluting Liquids. *Text. Colorist*, 1925, **47**, 717.

Deduct the desired density from that of the heavier liquid, the difference being the volumes of water to be mixed with volumes of the solution denoted by the decimal part of the required density, thus—Strong solution has sp. gr. 1·40, sp. gr. needed = 1·10, the difference is ·30, therefore 30 volumes of water should be added to 10 volumes of heavy liquid. For liquids lighter than water the gravity of the liquids is first subtracted from unity, thus—It is required to make a 4% solution of ammonia (sp. gr. 0·9831) from strong ammonia of 0·90 sp. gr.; 0·9 from 1 leaves 0·10; 0·9831 from 1 leaves 0·0169; the difference between these is 0·0831; therefore 831 volumes of water would be required for 169 vols. of strong ammonia. —F.G.P.

Wool Grades and Fineness of Fibre. —. Gordon. *Text. World*, 1925, **68**, 843.

The writer has made a study of wool with a view of establishing absolute standards of wool grading. The diameters of 100 fibres of different samples of different grades were measured by means of the microscope and the results of these figures are given in Fig. 1 attached. Approximate average diameters for lower limits of different grades are—Fine, 20 microns; ½ blood, 23½ microns; ⅜ blood, 29 microns; ¼ blood, 34 microns; low ¼ blood, 36 microns. The results of average diameters for American and English tops are given in Fig. 2. By comparison of the curves it may be seen that the grading of American and English firms agree fairly well. When deciding to which grade a sample of wool or top belongs, spread out wisps of fibres and mount in a mixture of 2 vols. of glycerine with 1 vol. of ethyl alcohol on two slides and measure ten fibres, starting from each side, of each of the two mounts. The average of the 40 fibres so measured should represent the sample. B.R.A.W. & W.I.

Textile Materials: Microscopy. F. J. Hoxie. *Text. World*, 1925, **68**, 3089.

The importance of microscope technique in the testing and study of textile materials is emphasised and photomicrographs are reproduced showing sections of artificial silk embedded in paraffin, of a cotton warp yarn embedded in nitrocellulose compound, mercerised cotton embedded in paraffin, and the penetration of a yarn by dye. —B.C.I.R.A.

The Seriplane. *Silk* (N.Y.), 1925, **18**, No. 12, p. 37.

The visual inspection is considered to be the simplest and best method of testing the grade of silk, both for the reeler and the user. The machine described has thick black boards on which the silk is wound at regular intervals, the length being 18 in., so that 1 yard is inspected on the two sides, or allowing for the thickness of the ends, one metre. One to ten boards may be used in the seriplane at one time, the distance between each strand of silk being regulated by a micrometer screw. The boards can be filed in a rack for subsequent more thorough inspection. The seriplane is used in the Yokohama and Kobe Silk Conditioning Houses, and also by many New York importers. It is equally useful for yarns of all descriptions. —F.G.P.

Tensile Testing Machines: Specifications. *Proc. Amer. Soc. Testing Materials*, 1925, **25**, i., 829-830.

Tentative specifications for textile testing machines state that the machines shall be of the inclination balance or pendulum type, the maximum angle of swing of the pendulum machines shall be 45° from the vertical, and the minimum diameter of drum for transferring the pull on the specimen to the swinging pendulum shall be 2 in. The capacity of the machine and types and dimensions of jaws to be used are specified. Machines are to be driven to produce a uniform and accurate movement of 12 in. per minute for the pulling jaw. —B.C.I.R.A.

Fabric Tension Meter. L. B. Tuckerman, G. H. Keulegan, and H. N. Eaton. *Phys. Rev.*, 1925, **25**, 900-901.

For measuring the tension in a fabric forming part of a structure, and of which only one side is accessible as in the envelope of an airship, the Bureau of Standards have designed an instrument which measures the deflections of suitably isolated portions of the fabric when subjected to known hydrostatic pressures. The instrument consists of an open chamber elliptical in cross section and provided with a pressure gauge and deflection meter. By means of a rim perforated with suction holes the elliptical portion of fabric is isolated. —B.C.I.R.A.

Schopper Paper Tester: Application. S. E. Sheppard, E. K. Carver, and S. S. Sweet (Eastman Kodak Co.). *J. Ind. Eng. Chem.*, 1926, **18**, 76.

Modifications suitable to the testing of films are described. A magnetic tapper connected to a time line records the downward movement of the clamp, and the rotation of a drum caused by the movement of the load weight records the load. A stress/strain diagram is thus obtained.
—B.C.I.R.A.

Sorption Balance. J. W. McBain and A. M. Bake. *J. Amer. Chem. Soc.*, 1926, **48**, 690-695.

The balance consists essentially of a spring balance in the form of a quartz spiral carrying a cup for holding the material under test. The spiral is calibrated with a microscope for known weights at four different temperature ranges. The spring is enclosed in a tube which can be sealed and which is surrounded in the region of the spring by a nichrome wire electric heater and connected at the other to an exhaust pump. Before exhausting the tube the liquid or vapour to be adsorbed is introduced in a sealed tube, and by adjusting the temperature after sealing by means of a thermostat and breaking the container the vapour of the liquid can be passed over the charcoal or other adsorbent on the balance. The balance provides a means of measuring the sorption of gases and vapours on solid surfaces over the widest range of experimental conditions of temperature and pressure, and, within limits, investigations of adsorption may be made below and above the critical point.
—B.C.I.R.A.

Cruger Fabric Micro-analyser. *Amer. Dyestuff Reporter*, 1926, **15**, 96-99.

This form of apparatus for analysing textile fabrics and fibres comprises a binocular microscope, the stage being movable across a horizontal scale. In the eyepiece is a needle pointer. The sample is viewed by light transmitted through opal glass screens. The number of warp threads is counted by noting the number of threads passing under the needle pointer for a given distance traversed by the microscope across the scale. The scale is provided with stop devices for accurate reading. Opaque samples may be viewed by reflected light. Reproductions of nine photographs of different materials viewed under the analyser are given in the article.
—B.C.I.R.A.

Hydrocellulose: The Chemical Analysis of Cotton. C. Birtwell, D. A. Clibbens, and A. Geake. *J. Text. Inst.*, 1926, **17**, T145-T170.

Acid, Sulphuric; The Estimation of, in Wool. H. R. Hirst and A. T. King. *J. Text. Inst.*, 1926, **17**, T101-T103.

Alkali; A New Method for the Estimation of, with Special Application to Wool. H. R. Hirst and A. T. King. *J. Text. Inst.*, 1926, **17**, T94-T100.

Cotton Hair: Rate of Loading and Strength. J. C. Mann and F. T. Pierce. *J. Text. Inst.*, 1926, **17**, T82-T93.

Wool Testing. See Section IB.

7—BUILDING AND POWER

(A)—Construction of Buildings

Textile Mill Laboratory: Design. G. B. Haven. *Proc. Amer. Soc. Testing Materials*, 1925, **25**, Part II., 416-424.

Useful plans are given for the equipment of a mill testing department, divided into a laboratory for the usual mechanical tests on yarn and cloth and a chemical laboratory with an annexe for fuel testing. A photographic dark room and simple humidity control are also provided. —B.C.I.R.A.

Dyehouse Equipment. See Section 41.

(B)—Fire Prevention

Self-ignition of Textiles. *Chemicals* (Dyestuffs), 1925, **24**, 135.

Mysterious fires in textile factories have sometimes been traced to spontaneous combustion of stored fabrics and it is stated that some types of silk are notoriously dangerous in this respect. In materials containing oil it has been found that oxidation takes place; an increase of temperature hastens this and finally may lead to ignition. A careful watch should be kept on such stocks. —F.G.P.

(C)—Power

Boiler Auxiliary Apparatus. P. W. Foster. *Text. World*, 1925, **68**, 3387, &c.

A general discussion on the value of air heaters, economisers, and water walls for increasing boiler efficiency and on the value of superheated steam in power plants. —B.C.I.R.A.

Carding Engine: Driving. W. A. Mayor. *Text. World*, 1925, **68**, 3383, &c.

An account is given of a special motor and control, developed by the General Electric Co., for individual application to cotton cards, also a special motor and control for the stripping process. The following advantages of the individual motor drive for cotton cards are noted—The start of the machine is better as the motor picks up the load with a positive gradual acceleration. Production is increased because belt slippage is eliminated. Overhead shafting and belting and consequent oil dripping, and static electricity from belting are eliminated. Grinding is facilitated as it is only necessary to move the handle of the reversing switch to reverse the card Lighting and general atmosphere are improved by omission of the belting.

—B.C.I.R.A.

Stationary Belts: Transmissive Power. C. A. Norman. *Mech. Eng.*, 1925, **47**, 111-1113.

The following conclusions were drawn from an investigation of the transmissive power of belts hung over a slowly revolving pulley. The transmissive power of leather belts on cast-iron pulleys shows, within certain limits, a tendency to increase with slip. The tendency is especially marked with certain mineral tanned leather belts and oak tanned belts which have passed through a running-in period. With certain rubber belts and balata belts the increase of transmissive power with slip reaches a maximum beyond which no further increase takes place. The percentage of maximum tension converted into effective pull may, however, remain creditable beyond this point. This percentage is greatest for the special mineral tanned belts investigated. It is very high for a leather belt which has been run for some time and is high for balata belts. It exceeds 60 and even 70% for some rubber and impregnated fabric belts. New oak tanned leather belts, not run in, convert into effective pull a smaller fraction of the maximum tension. Rubber, balata, certain textile, and the special mineral tanned belts give their full service from the start. A few months' running does not seem to impair the transmissive power of rubber belts. The conclusions, whilst strictly applicable only to the belts tested and the test method used, seem to agree with certain tests on running leather belts.

—B.C.I.R.A.

High-pressure Steam: Properties. J. H. Keenan. *Mech. Eng.*, 1926, **48**, 146-149.

A steam chart is given showing total heat-entropy relations for steam at high pressures, together with a table showing the specific volumes of saturated and supersaturated steam in cu. ft. per lb. at pressures from 1-1200 lb. per sq. in., saturation temperatures from 101·8-567·7° F. and superheat temperatures from 0-400° F.

—B.C.I.R.A.

Textile Machinery: Driving. C T. Main *Mech. Eng.*, 1926, **48**, 125-127.

A discussion of steam and water power in textile mills as compared with purchased electric current. In new mills, plain goods mills of moderate size can probably purchase current cheaper than it can be generated by a mill plant, whilst coloured goods mills can usually produce power and steam and warm water for manufacturing processes cheaper than they can purchase electric current and produce the required amount of steam and warm water. In existing plain mills, the replacement of old and inefficient steam plant or its replacement by an electrical installation depends on circumstances. —B.C.I.R.A.

"Texrope" Drive: Description. Allis-Chalmers Mfg. Co. *Cotton* (U.S.A.), 1925, **90**, 179.

The Texrope drive is an entirely new type of short centre, flexible drive consisting of two grooved sheaves and a number of specially constructed endless "V" belts. The sheaves are set far enough apart so that the belts just fit the grooves, without either tension or slack. The drive occupies very little space. It is silent, clean, and said to be unaffected by moisture or dirt, whilst bearing pressures are low.

—B.C.I.R.A.

(D)—Lubrication

Machine Bearings: Lubrication. G. B. Karelitz. *Mech. Eng.*, 1926, **48**, 128-131.

Charts are presented which afford an easy means of determining the shape of the oil film and the pressures in it for bearings under different conditions. —B.C.I.R.A.

(F)—Lighting

White Paint: Brightness and Opacity. F. H. Rhodes and J. S. Fonda. *J. Ind. Eng. Chem.*, 1926, **18**, 130-135.

A formula is developed to express the relation between the brightness of a film of white paint and the thickness of the film, and experimental evidence in support of the formula is advanced. The effect of the addition of a small amount of black pigment in increasing the hiding power of white paint is explained. Attention is called to the possible effect of the roughness of the surface of a paint film upon the brightness of the film. —B.C.I.R.A.

Artificial Daylight Filters: Spectral Centroid Relations. K. S. Gibson. *J. Optical Soc. America*, 1925, **11**, 473-478.

It is shown that linear relations exist between the spectral centroid (i.e., the wave length centre of gravity of the luminosity curve) and the thickness of daylight glass and between the spectral centroids of the incident and transmitted light.

—B.C.I.R.A.

Ultraviolet Light Intensimeter. A. Gyemant. *J. Optical Soc. America*, 1926, **12**, 65-68.

A new method is described of measuring the intensity of ultraviolet radiation by measuring photometrically the intensity (brightness) of visible fluorescent radiation produced, in certain substances, by ultraviolet light. —B.C.I.R.A.

Artificial Daylight by Dyes. *Text. Colorist*, 1925, **47**, 717.

A formula is given in grams per square meter of gelatin sheet to be dyed to such a shade that the light from an ordinary tungsten filament lamp will more or less resemble daylight. Toluidine Blue 1·2 gr., Filter Violet 0·1, Fast Red D 0·1, Methylene Blue 1·2, Rapid Filter Red I 0·16, Orange II 0·08. The dyes are dissolved separately and then mixed together with a weak gelatine solution before applying to the sheets. This is said to be of English origin and sufficiently accurate for most purposes. —F.G.P.

(H)—Humidification

Textile Mills: Illumination. R. L. Zahour. *Text. World*, 1925, **68**, 3391, &c.

Some general factors to be considered in the production of efficient illumination in textile mills are discussed. Porcelain enamelled steel reflectors with white bowl Mazda C lamps hung 10 to 12 feet above the floor are recommended.

—B.C.I.R.A.

Air Conditioning and Mill Operation. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 11, p. 45.

The great advantage of humidifying apparatus is shown both in money and effect on the workers. A table is given showing the regain on Japan raw silk at 70° F. If the relative humidity is 20% the regain is 7%, while if R.H. is 90% the regain is 15·4%. On a cold dry day static electricity causes continuous trouble by the breaking of threads, while on warm damp days considerable delay is caused by the sticking of warps and harness.

—F.G.P.

8—DESIGN

Painters and Prints. K. L. Green. *Silk* (N.Y.), 1925, **18**, No. 11, p. 85.

The author discovered that American designers were only copyists who imitated French prints without understanding the theory underlying them. Therefore, the naturally-artistic American women refused the local goods in favour of the foreign. The author got together a committee of American artists and obtained from them designs for silk prints which were immediately successful. He is of the opinion that a good artist is a good silk designer.

—F.G.P.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Cotton Industry in the U.S.A.: Business Cycles. L. Bader. *Text. World*, 1925, **68**, 2615-2617.

The causes of cyclical fluctuations in cotton manufacturing are explained, especially in as far as they affect the U.S.A. industry. Normally, these fluctuations approximate closely to the general business cycle, but in 1924 the slump in manufacture was altogether abnormal. By 1923 the extravagant war and immediate postwar consumption had slackened, and much of the increase in capital equipment, which arose to meet the demand, became superfluous. In consequence 1923 production carried huge surplus stocks into the business year of 1924, causing a marked slump. The 1924 year exaggerated the wastage and dislocation of the usual period of depression, of the business cycle, and the author inquired whether these depressions are necessarily recurrent. Some of the wastage could be eliminated if (1) further over-expansion of capital equipment, (2) over-expansion of stocks of finished goods, and (3) excessive output were prevented. In order to do this the collection of better and more complete statistical data is required. The second need is a better utilisation of the statistical data so gathered in connection with a good interpretation of current economic conditions. No effective means have been discovered for discouraging the further building of mills, until the market demand catches up with the production capacity; and mill erection in the south continues at the expense of the cotton industry in New England. The remedies open to the mills in the latter area lie in the best possible utilisation of present equipment; wherever possible a transference to advantageous locations in the south is advised; and where this is impossible and complete unit additions are contemplated, they at least should be located in the south, to form the nucleus for expansion as the present plants in New England depreciate. Otherwise New England mills that must remain where they are have the following courses open to them—(1) To produce a more valuable cotton product. (2) Build a good market for their products by modern marketing methods. (3) Form a vertical combination that will entail manufacturing clothing and other textile articles from their own fabrics and making direct contact with retailers, using the best advertising and sales methods now known.—B.C.I.R.A.

Cotton Industry in Japan: Expansion. *Text. World*, 1925, **68**, 2617.

A twofold increase in spindles, a sevenfold increase in looms, an increased consumption of cotton by one million bales, a hundred per cent. increase in yarn production and a sevenfold increase in cloth production is

reported by the Japan Cotton Spinners' Association as occurring between 1905 and 1924. Yarn production of counts above 20's is almost 63% of the total, namely, two million bales, and though yarn exports are down to pre-war level, over 50% of these exported yarns is over 20's. The great increase of yarn production is put into domestic cloth manufacture, which in 1924 amounted to over 1,000 million yards as contrasted with 115 million yards in 1905. China and India are Japan's best export outlets for cotton piece goods and the Netherland East Indies, Africa, Hongkong, and Kwantung Province follow in order. The first half of 1925 exports included 200 million yards to China, 80 millions to India, 48 millions to the N.E.I., 22½ millions to Egypt, 13 millions to other parts of Africa, 12 millions to Singapore, 10 millions to Arabian Persia, and 8⅔ millions to the Philippines. —B.C.I.R.A.

Ecuador's Textile Industry Expanding. *Chemicals*, 1925, **24**, No. 12, p. 9.

Although the first textile mill was erected over 50 years ago, the real growth of the industry has occurred during the past five years; a large plant has been erected at Quito, a mill in Riobamba has largely increased its output, and a factory in Ambato now has an output valued at $24,000 annually. The industry employs about 2,000 persons; labour is cheap, Indian boys and girls earning 30 cts. per day, but though industrious their efficiency is very low. Working conditions are fairly good. The technical supervision is either British or American. There is no hint as to whether the industry is silk, wool, or cotton. —F.G.P.

The Manufacture of Rayon. *Chemicals* (Dyestuffs), 1925, **24**, 145.

It is stated that $100,000,000 is the capital invested in America in rayon plant and machinery at the present time. In 1924, the output was 38,850,000 pounds. The amount of silk imported during that year was 39,551,000 pounds. It is prophesied that in 1927 the world's output of rayon will be 200 million pounds, with Italy as the largest producer (66 millions). A brief description is given of the manufacture of the four kinds of rayon and some notes of their properties. —F.G.P.

Progress of Textile Industries in Italy. *Color Trade J.*, 1924, **15**, 151.

Among the countries of Europe Italy is the greatest producer of silk, accounting for 15% of the world's output. It is thought that sericulture is very arduous. Before the war silk production fell off to the extent of 25% and the destruction of mulberry plantations by the enemy during the war caused a further decline. Other plantations were used for fuel. Owing to all causes, the cocoon harvest fell from 103 million pounds in 1914 to 45 millions in 1919. Great efforts made since the war have raised the output of raw silk from 4,705,000 lb. in 1919 to 11,506,000 lb. in 1923. Italy is not a great exporter of manufactured silk goods. —F.G.P.

The Artificial Silk Industry in England. *Color Trade Jl.*, 1924, **15**, 156.

England is said to be one of the leaders in rayon production, the output having risen from 6 million pounds in 1913 to 30 millions in 1924. The output of acetyl cellulose has got up from 2 tons a day in 1923 to 10 tons a day in 1924; this is stated to imply a yearly production of 6 million pounds. Many mills which used to make cuprate fibre are turning over to viscose. —F.G.P.

Cotton Industry in the U.S.A.: Progress in 1923. Textile Division, American Society Mechanical Engineering. *Mech. Eng.*, 1925, **47**, 1139-1140.

A short review of progress in the American textile industry during the year 1923. Raw materials, machinery, mill construction, handling of materials, power, standardisation of products, research, and management are dealt with. Among new trends in machinery are noted (1) adaptations to new or lower grade fibres, (2) refinements in design and construction, (3) standardisation, (4) arrangement of machines in series, tandem fashion, (5) higher speed drying equipment, (6) centralised control of lubrication on calenders, (7) improved equipment for mixing raw fibres, and (8) improved driving clutches. —B.C.I.R.A.

Cotton Fabrics in the U.S.A.: Statistics. C. H. Clark. *Trans. Nat. Assoc. Cotton Mfrs.*, 1924, **116-117**, 388-415.

The cloth production in the United States according to the 1921 census is classified under 29 heads and grouped into fashion or style fabrics and the opposite. The figures are discussed at some length. It is shown that the proportion of the trade which is influenced by fashion is relatively small, suggesting that there is room for expansion by the more efficient, and artistic styling of fabrics. The place of research in designing fabrics to meet definite requirements is also mentioned. It is claimed, for example, that the modern tyre fabric would have been possible years ago had a proper investigation into the demands been made. —B.C.I.R.A.

10—MISCELLANEOUS

Segregation in Half-bred Sheep. J. E. Nickols. *J. of Heredity*, 1925, **16**, 401.

The author describes the characteristics of Border Leicester and Cheviot pure breeds with regard to the fleece, general body build and head and compares these with the

half-bred ewes and lambs by means of photographs. On the whole, the half-bred shows characteristics intermediate between the two parents. Experiments have been carried out, where a suitable Border Leicester ram was crossed with Cheviot ewes and from their offspring 114 were used for breeding purposes. These were mated to two first cross Border Leicester cross Cheviot rams and the offspring showed distinct evidences of segregation, particularly in fleece characteristics. The total numbers in classes of the F2 among 186 were—Border Leicester 34, half-bred 115, indefinite 36, with three almost typical Cheviots, and one Cheviot. That, therefore, half-breds breed true has no foundation, when the first half-bred is considered. Yet among certain flocks where mating half-bred to half-bred has been carried out for many generations, almost pure breeding strains have been formed by careful selection. Many animals among these flocks have proved to be superior even to the first crosses as mutton and breeding sheep. B.R.A.W. & W.I.

Phosphor Bronze Helical Springs: Performance and Design. W. G. Brombacher. *J. Optical Soc. America*, 1925, **11**, 519-547.

Performance tests on a number of specially designed and constructed phosphor bronze helical springs are described. The data obtained consist mainly of measurements of the deflection of the spring under loads which were applied so as to put the springs in compression. The work is discussed in relation to the design of precision instruments. In the course of the investigation an apparatus for determining the modulus of torsion of spring wire was specially designed and nomograms for use in the design of helical springs were prepared. —B.C.I.R.A.

Steel Springs: Manufacture and Characteristics. F. H. Brown, J. W. Rockefeller, jun., and B. W. St. Clair. *Mech. Eng.*, 1925, **47**, 1053-1055, 1056, and 1057-1058.

General lectures on the manufacture of commercial steel helical springs, the characteristics of springs used in the construction of weighing machines and the requirements of springs for electrical measuring instruments. —B.C.I.R.A.

Glass-lined Steel Container. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 11, p. 46.

For the storage and transport of corrosive and organic liquids steel vessels lined with glass offer many advantages. Mixers may have bronze or plated stirrers, and it is possible to get steam jacketed tipping vessels. —F.G.P.

Massachusetts Institute of Technology: Review and Abrasion Resistance Tester. G. B. Haven. *Trans. Nat. Assoc. Cotton Mfrs.*, 1924, **116-117**, 171-189.

A report of researches. Sections I. and II. deal with moisture contents and rates of regain, and mention a "regain scale" by which the regain of a fabric may be read directly. Light fabrics are said to pick up nearly all the regained moisture in the first half hour whilst one hour should be sufficient to condition any average fabric. Section III. deals with the measurement of porosity in felts and ducks. Porosity to air and water stand in direct relation and a pneumatic test is therefore possible. An instrument is mentioned. Section IV. discusses the measurement of crimp and take-up in weaving and Section V. the development of a constant rate of loading testing machine for fabrics. Section VI. describes a device for testing resistance to abrasion and flexure, consisting of a hard steel blade, $\frac{3}{16}$ in. thick, with a semicircular edge over which the fabric is stretched under a load equal to its weight in ounces per square yard. The blade is given a vertical oscillation of 6 in., whereby it rubs the fabric and folds it through 180°. After a few thousand motions of the blade the fabric is unravelled to a strip 1 in. wide and tested on a tensile machine. —B.C.I.R.A.

Bloom Gelometer. See Section 6, "Glue Viscosity."

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—ANIMAL

Silk Fibroin. R. Brill. *Annalen*, 1925, **446**, 307-308.

The results of the author's previous work on X-ray examination of silk fibroin (*Annalen*, 1923, **434**, 204-217) are discussed very briefly. He concludes that silk fibroin is composed of a mixture of two proteins, the preponderant component of the mixture being crystalline. He considers that the crystalline component is a compound of alanine and glycine in molecular ratio and that the X-ray photographs of the crystalline component of silk indicate the presence of a methyl-di-keto-piperazine ring; an analogy is drawn between the structure of the silk crystal and that of Bergmann's di-keto-piperazine compounds (*Annalen*, 1925, **445**, 1). —B.S.R.A.

Silk Weighting. R. O. Herzog and H. W. Correll. *Z. angew. Chem.*, 1926, **39**, 380-381.

X-ray examination was made of samples of silk weighted 5-160% above par. The diagram obtained with tin phosphate silicate weightings of 5-20% showed no noticeable difference from that for unweighted silk; but more heavily weighted material gave interference rings due to the weighting material itself. The ordinary silk diagram was obscured by the separation of amorphous material in the case of tin phosphate alumina-silicate weighted silk. The results are said to show that the weighting material is in a crystalline form not combined with the silk and is probably contained in the intercellular spaces embedded in the degradation products of the fibre. —B.S.R.A.

Fibres: Structure. R. O. Herzog. *Z. angew. Chem.*, 1926, **39**, 297-302.

A useful summary of recent knowledge of the structure, mechanical and chemical properties, and technical application of animal and vegetable fibres. —B.C.I.R.A.

Mohair Wool and its Production. A. Lervy. *Melliand's Textilberichte*, 1926, **7**, 369 (from *L'Ind. Text.*, 1925, **41**, 441-442).

The hair of the Angora goat, commonly called mohair, is one of the natural treasures of Asia Minor. The mohair goat is distinguished from the European goat by means of horns which are bent backwards, a smallish body rich with long wavy white, yellowish, and black hair. The Angora types are classified into Cashmere and Tibet goats. They live at heights from 700-1,000 m. and avoid low-lying valleys with mild climates. They favour dry and hot summers and keen winters. During the winter their hair becomes fine, long and lustrous. Their food consists of short fatty grasses. The more nourishing and plentiful the food is, the better the wool. The most popular wools come from Beybazar, Eski-Cheir, Karahissar, and Nallikan. Before the war the annual production amounted to between 30,000 and 60,000 bales of 75 to 80 kg. To-day the production is about the same as pre-war. Shearing takes place once a year in April or May. A fleece weighs about 2 kg. The Angora goat has been exported to Cape Colony and North America and they are now being bred there. —B.R.A.W. & W.I.

Influence of Sunlight on Wool. W. von Bergen. *J. Soc. Chem. Ind.*, 1926, **45**, B312 (from *Textilberichte*, 1925, **6**, 745-751).

After exposure to sunlight, wool swells strongly in dilute alkali and crumples characteristically, it shows no double refraction between crossed nicols. Acids promote the decomposition of the wool molecule and the oxidation of the liberated sulphur to sulphuric acid. Alkalis hinder the oxidation of the sulphur and neutralise the acids formed. Free sulphuric acid causes yellowing of the wool. After treatment with sunlight wool is dyed more deeply by basic dyestuffs, and less so by acid dyestuffs.

(C)—VEGETABLE

Russian Textile Fibres; Standards of——. *Revue Textile*, 1926, **24**, 33-39.

A complete table is given of a new classification of Russian flax and hemp according to place of origin and quality. —L.I.R.A.

Cotton Cultivation in Dahomey. *L'Avenir Text.*, 1925, **7**, No. 12, p. 15.

The cultivation of cotton is extending steadily in Dahomey. Seed has been distributed, especially in the north of the colony and the Government sees that old plants are burned to avoid propagation of disease. The cultivation of cotton has been undertaken on a large scale in the Kouande area, which has hitherto produced cotton to a small extent only. —B.C.I.R.A.

Cotton Pests: French West Africa. P. Vayssière and J. Mimeur. *Rev. Appld. Entomol.*, 1926, **14**, Ser. A, 6-9 (from *Agron. colon.*, 1925, No. 93, 89-125, and No. 94, 166-190).

The life history and control of the following pests of cotton in French West Africa are discussed: *Microtermes* (*Ancistrotermes*) *soudanensis* which causes the plant to wilt by mining the young stems, *Sphenoptera*

gossypii, which is also a stem miner, and *Mylabris affinis* adults, which devour the petals and stamens of cotton flowers and sometimes enter the buds, though they cause very little damage and may assist in fertilisation. *Nisotra uniformis* and *N. dilecta* are frequently found on the lower surface of leaves of young plants, where they destroy the parenchyma. The larvæ of *Chilena obliquata*, which occurs in very small numbers, attacks the leaves. *Diparopsis castanea* occurs on cotton, *Prodenia litura* attacks the parenchyma of cotton, *Xanthodes intercepta* feeds during the day on both surfaces of the leaves but is not numerous, *Cosmophila flava* feeds on all species of cotton but is not abundant, *Diacrisia punctulata* is present in small numbers, *Acrocercops bifasciata* attacks cotton in the cotyledon stage and *Corcyra cephalonica* attacks stored goods, including cotton seed. In an appendix, the characteristics and distribution of *Platyedra gossypiella*, for which treatment of the seed with chloropicrin is an effective control measure, is discussed. *Tenebrio guineensis*, two species of *Myllocerus* and *Alcides gossypii* occur but do not rank as pests. An extensive bibliography is provided. —B.C.I.R.A.

Fibre Content in Hemp (*Cannabis sativa*) **in Relation to Different Conditions of Growth.** A. v. Lucke. *Faserforschung*, 1925, **5**, 1-36.

The author gives data showing the rapid decrease in the area under cultivation for hemp in Germany and, with the view of stimulating interest in this crop, he gives the results of experiments undertaken to find out the effect of different rates of sowing, different distances between the rows, and various manurial treatments upon the external characters and the fibre content of the plants. He decides that increasing the quantity of seed or lessening the distance between the rows causes a greater length of stem, but a smaller diameter, the total result being a higher yield of stem but a smaller yield of seed. He finds that thickness of the stem and seed yield are correlated. The influence of manures works equally favourably upon the length and thickness of stem and upon seed yield. The percentage of seed decreases with increased quantity of seed sown, decreased distance between the rows and increased manures. The fibre content is higher, the greater the stem length and the smaller the stem thickness. It will be increased therefore by thick sowing and smaller distances between the rows and diminished by increased manuring. A valuation of hemp according to the stem thickness appears possible, and indeed, in hemp of equal length, the thinner is of higher value than the thicker. The author gives at the end of the paper an account of Bredemann's method of obtaining fibre from unretted straw by boiling it in a 1·5% solution of caustic soda. —L.I.R.A.

Nitrogenous Fertilisers and Flax. M. Grohs. *Faserforschung*, 1925, **5**, 37-51.

This paper is an extract from a larger work and deals especially with the effect of nitrogen on the quantity and quality of fibre as well as on the total yield of flax. Weak and strong dressings of Chili saltpetre, ammonium sulphate, and calcium nitrate were used, in addition to a dressing of potash and superphosphate, and the plots so treated were compared with plots treated with potash and superphosphate only, as well as with a single plot which had received no manure at all. Tables are given showing the effect of the manures upon the harvesting and subsequent working of the flax, the yield of straw and seed, and the internal structure and strength of the fibre. In all the tests the flax from the plots manured with potash and superphosphates only, proved superior to that from the plots which had received an additional dressing of nitrogen. Of the three forms of nitrogenous manures used, Chili saltpetre gave the best results on the whole, for the particular year in which the experiment was carried out, but the author states other experiments show that those results were exceptional on account of the dry weather and asserts that under more ordinary weather conditions, ammonium sulphate gives smaller but more certain profits and is therefore to be recommended more than any other form of nitrogenous manure. —L.I.R.A.

Hibiscus cannabinus L; **Disposition of Fibres in the Stem of——.** A. Horst. *Faserforschung*, 1925, **5**, 52-58.

The work described in this paper deals particularly with the amount of fibre in different parts of the stem of *Hibiscus cannabinus*, and by cutting the stems into thirds in one experiment and into quarters in another, the author finds that the lower part has the greatest amount, but the middle part has the highest percentage. Tables are also given showing the relation between quantity of fibre and length of stem, and the author advances the suggestion that the amount of fibre increases in proportion to the square of the relative increase in the length of stem; therefore by increasing the length of the crop, a considerable increase in the yield of the fibre can be effected. —L.I.R.A.

Acidity; The Importance of Soil, for Flax Growth. H. Selle. *Faserforschung*, 1926, **5**, 146-152.

The author investigates the truth of the idea, which, according to him, prevails that flax grows best on a weakly acid soil. By comparing the results of analyses of samples of soil taken from various fields of flax which were judged on the basis of its length, thickness of stem, seed yield, uniformity and economic value, he finds that the best crops occur on weakly alkaline soil. He explains the discrepancy

between the two views on the ground that an acid soil is more favourable than an alkaline to the activity and multiplication of the nitrifying bacteria, and therefore the superiority of the alkaline soil can only show itself when it already possesses a sufficient quantity of available nitrogen. The investigation into the effect of the acidity of the soil upon the strength and spinning quality of the fibre is postponed until after the harvest of 1925 has been examined. —L.I.R.A.

Fermentation Baths for Various Textile Fibres. W. Hacker. *Faserforschung*, 1926, **5**, 153-154.

The author very briefly describes fermentation processes which may be used for "degumming" flax, hemp, ramie, and jute. For example, according to a patented process for the treatment of raw ramie, low quality fibre is steeped at 30° C. in 20 times its weight of a solution of ammonium chloride. The brown, alkaline, evil-smelling liquor is then added to raw ramie steeping in water. After a few days' fermentation the woody parts are completely separated from the fibre. The plant-gum is dissolved by boiling for three hours under two atmospheres pressure in dilute caustic soda. The fibre is then washed and given a suitable mechanical treatment. —L.I.R.A.

Central Africa; Flax Cultivation in——. *Times Trades and Engineering Supplement*, 1926, **18**, 134.

From the results of several years of experiments in producing flax fibre in the Congo, it seems to be established that in certain regions of Central Africa this crop can be grown of a quality suitable for spinning. The questions of elevation and the period of sowing are important points to be considered. In low-lying ground the quality of the fibre is inferior. In regions which have a dry season, the best crops have been obtained when the seeds have been put in at least four months before the close of the rainy period. The seed must not be sown so thickly as in Europe; 100 kg. per hectare ($2\frac{1}{2}$ acres) seems to be the maximum. On fertile land several successive crops have been obtained and the maximum output amounted to 300 kg. of fibre per acre. The most difficult problem is retting the fibre. Fermentation takes place rapidly, as the rain which falls in Central Africa is much warmer than that in Europe. The ravages of insects, ants in particular, constitute another difficulty. With dew retting, successful experiments have been made. Tests have been carried out on Congo flax in a Belgian spinning mill and these have shown results equal, if not superior, to those derived from the best Russian flax. The product has been found to be suitable for making warp threads, although there has been criticism that the flexibility of the material leaves something to be desired. —L.I.R.A.

Cotton Plant Diseases in Armenia. P. Kalatarian. *Bot. Centr.*, 1926, **148**, 476 (from *Zentr. f. Bakt.*, 1926, **65**, 297-301).

In May 1924 cotton plants in Armenia were found to be infected with a disease which attacked the roots and caused wilting. The disease was traced to the presence of a peripherally flagellated bacillus (*Bact. erivanensi*). Infection experiments on three weeks' old seedlings were positive. The different varieties of cotton infected were attacked in very different degrees. In August cotton plants were observed with leaves pale yellow between the veins, which dried up in a few days; in 10-15 days the plant died. The vascular bundles of the plant showed dark brown colouration but not those of the leaf stalk. From the vessels was isolated a bacillus with a terminal flagellum (*Bact. Lōhnisi*). —B.C.I.R.A.

Fibre Plants of Japan. K. Ohara. *Faserforschung*, 1926, **5**, 157-162.

In a paper dealing with the various plants cultivated in Japan for their fibre, the author mentions that contrary to the general belief of Europeans, flax is cultivated to a small extent and some linen is exported. Scientific work has been done on the biological and chemical nature of the flax fibre, especially in the University of Hokkaido (Jezo). —L.I.R.A.

Flax Variety Trials in Germany. W. Muller. *Faserforschung*, 1926, **5**, 162-179.

The author gives an account of variety trials carried out in Germany in 1924, on several pedigree strains compared with Riga and Dutch White. The flax was grown in different parts of the country, and the harvested crops sent to Sorau for examination and valuation. All the pedigree varieties were judged to be better than Dutch White and Riga, the first place being given to Bensing I. —L.I.R.A.

Flax Straw; Fineness and Uniformity of——. R. Weck. *Faserforschung*, 1926, **5**, 193-195.

The author gives a formula for calculating approximately the diameter of single flax stems from the circumference of a bundle of 100 straws. —L.I.R.A.

The Convolutions of the Cotton Hair and the "Beading" produced by Treatment with Ammoniacal Copper Hydroxide Solutions. B. Vloek. *Melliand's Textilberichte*, 1926, **7**, 361-364.

The author discusses the causes of the well-known "beading" produced in cotton hairs by treatment with Schweitzer's reagent. This effect is often produced by the irregular rupture of the cuticle and the constricting action of the fragments so produced. The cuticle is itself often of uneven thickness, sometimes showing a spiral thickening which causes the cuticle to split spirally under the action of the

reagent. Rupture of the cuticle is sometimes transverse especially in hairs with very thick cuticles. The presence of convolutions in the hair are also sometimes the cause of beading, apart from the constricting action of the cuticle. —L.I.R.A.

Lignification; Biochemical and Histological Studies on——. Part II. Histological Studies on the Polysaccharides and Aromatic Constituents of the Cell Wall. M. M. Mehta. *Biochemical J.*, 1925, **19**, 979-997.

An attempt has been made to unravel the microchemical structure of plant tissues and to interpret in chemical terminology the distribution of the different units comprising the cell. The results of a comprehensive series of staining tests applied to cellulose -α, -β, and -γ oxycelluloses -α -β, and -γ, hydrocellulose, mannan, galactan, pectin, amylohemicellulose, hemicellulose, gums, starch, lichenin, and chitin are tabulated. —L.I.R.A.

Modern Views on Cotton. A. J. Hall. *Dyer and Calico Printer*, 1926, **55**, 184-185.

A further discussion of the impurities present in raw cotton having particular regard to nitrogenous substances. A relationship exists between the amounts of phosphorus and nitrogen in raw cotton, both being related to the type of cotton. The removal of nitrogenous substances from cotton by various processes of kiering and bleaching is described. —A.J.H.

Pink Boll-worm Occurrence in Barbados. *Tropical Agric.*, 1926, **3**, 23.

Cotton cultivation in Barbados is suffering from the ravages of the pink boll-worm, but the boll-weevil has not yet been reported in the British West Indies. —B.C.I.R.A.

Flax Variety Trials: 1924. *J. Dept. Lands and Agric.*, 1926, **25**, 411.

A variety experiment to ascertain the comparative values of the following varieties was carried out during the season 1924 at eight centres—Danish Pedigree No. 40; Danish Pedigree No. 21; Dutch (White Blossom); Riga Child; Pernau Crown; and Riga. A table is given showing the yield per statute acre of scutched flax, the percentage of scutched flax from retted straw, the value of scutched flax per stone, and the return per statute acre from the scutched flax for each variety. The varieties are given above in the order of their monetary return. —L.I.R.A.

Flax Variety Trials: 1925. *J. Dept. Lands and Agric.*, 1926, **25**, 432.

A quantitative variety experiment with flax was carried out during the season 1925 at seven centres. Riga, Pernau Crown, and Dutch were grown at all centres. Danish No. 21 and the Department's pure line No. 6—two pedigree selections—were included in addition at two of the centres. A table is given showing the weight of scutched flax and the value of scutched flax per statute acre. On the average of the seven centres, Riga flax was superior to Pernau Crown and Dutch flax. On the average of the two centres at which they were grown, Danish No. 21 and the Department's pure line No. 6 proved definitely superior in yield and value of scutched flax per statute acre to the other varieties included in the test. —L.I.R.A.

Field Experiments: How they are Made and What they are. Sir J. Russell. *J. Min. Agric.*, 1926, **32**, 989-1001.

An elementary and very clear description is given of some of the essentials of properly conducted field experiments. Various arrangements of field plots, including the side-by-side chess-board, balanced strips and the Latin square are described briefly with the advantages and disadvantages of each. —L.I.R.A.

Aphides Infesting Bulbs in Store; The Control of——. R. Stenton. *J. Min. Agric.*, 1926, **32**, 1037-1041.

In the course of a description of aphis control, it is stated that better results are obtained, when using *p*-dichlorobenzene as a fumigant, if this substance is dissolved in carbon tetrachloride and then impregnated into sacking or blanket material. The carbon tetrachloride evaporates quickly, leaving *p*-dichlorobenzene to be slowly given off by the cloth. Under these conditions there is a considerable savingof *p*-dichlorobenzene. —L.I.R.A.

Pink Bollworm Control in Montserrat. *Tropical Agric.*, 1926, **3**, 23.

A report of observations on the pink bollworm in Montserrat during the cotton season of 1925. The pest increases in the severity of its attack during the season. Early in the season it is usual to find one larva in a boll but the number increases until, at the end of the season, there may be as many as eight. It is estimated that the loss of cotton in Montserrat due to pink bollworm is equal to about 25% of the total crop, the damage amounting to about £10,000. Emphasis is laid on the importance of thorough cleaning up in the fields, of the necessity of early planting and ripening, of early destruction of the old cotton plants and of enforcing the provisions of the close season. —B.C.I.R.A.

Boll Weevil Control in India. Indian Central Cotton Committee, *Abstract Proceedings, 11th Meeting*, 1925, Appendix 10, p. 76.

It is proposed that the importation of American cotton into India should be allowed only after proper fumigation. The cotton will be landed only at Bombay,

where the fumigation plant will be available. As fumigation must take place on the barges, it cannot satisfactorily be performed during the monsoon period; and it is therefore proposed to limit the importation to the fair season between 1st November and 31st May. The charge is estimated at not more than Rs. 3 per bale.
—B.C.I.R A.

Seed Steeping; A New Method of——. E. W. Fischer and K. Scharrer. *Rev. App. Mycology*, 1926, **5**, 117 (from *Chem. Zeit.*, 1925, **49**, 757-758).

The writers have devised a process of seed steeping which they believe obviates the disadvantages of the liquid solutions and dusts in common use. Experiments with various liquids having a lower boiling-point than water showed trichlorethylene and, under certain conditions, carbon tetrachloride are eminently adapted to use as seed steeps. Flax seed immersed for half an hour or one hour in either of these solutions, dried a few minutes after removal without the usual formation of slime. The germination of the seed was improved and parasitic attacks prevented. A special apparatus, worked by hydraulic pressure, has been devised for the application of these solutions, the requisite amount of which has thereby been reduced to a minimum in view of their high cost.
—L.I.R.A.

Seed Treatment; A New Method of——. W. E. Fischer and K. Scharrer. *Rev. App. Mycology*, 1926, **5**, 173 (from *Illus. Landw. Zeit.*, 1925, **45**, 531).

In connection with their new method of seed treatment (see previous abstract) the writers briefly describe an experiment in which rye seed grain heavily infected by *Fusarium* (*Calonectria graminicola*) was immersed (*a*) in a well-known fungicide at the prescribed strength and duration; and (*b*) in the same preparation combined with trichlorethylene and carbon tetrachloride, which are stated to be suitable for use in conjunction with most of the recognised preparations on the market. While a considerable percentage of lot (*a*) showed fungous and bacterial infection, there was no trace of any contamination in (*b*). Excellent results were also obtained by similar treatment of flax seed, which was absolutely dry within a few minutes of removal from the disinfectant, even after 24 hours' immersion. —L.I.R.A.

Sisal Growing in Mozambique. C. de M. Geraldes. *Bull. Imp. Inst.*, 1925, **23**, 484-485 (from *Rev. Bot. Appl. et D'Agric.*, 1925, **5**, 500).

The cultivation of sisal was introduced into Mozambique in 1904 and has undergone great developments since 1911. Information is given regarding the climate, rainfall, temperature, and soil of the country and reference is made to the different methods of cultivation and preparation of the fibre as adopted by the various companies at work. The life of a sisal plantation is stated to be from six to eight years and the period during which leaves are cut from three to five years. Mention is made of the various types of extraction machinery employed. Some of the fibre exported is of very good quality, whilst some, although of good quality, could be improved by more careful preparation. The quantity of the fibre exported has increased steadily each year, since 1918. —L.I.R.A.

Temperature on Retting Water; The Significance of the——. —. Schurhoff. *Leipziger Monats. Text. Ind.*, 1926, **41**, 74 (from *Dtsch. Leinen Industrielle*, 1925, No. 17, p. 354).

From the results of numerous experiments the author concludes that a temperature of 18-21° C. in retting gives the best yield and quality of fibre. —L.I.R.A.

(D)—Artificial

Cellulose Acetates: Stability; and Sulphocelluloses: Preparation. A. Caille. *Chimie et Industrie*, 1925, **13**, 11T-13T.

In continuation of previous work on the stability of cellulose esters the author prepared sulphocelluloses by treating cotton with 100% sulphuric acid and glacial acetic acid (1:1) for 30 mins. at 45°. Washing with river water containing lime for 2-3 hours had little hydrolytic effect on the products, and it was found that with continued washing the stability of the sulphocelluloses increased in proportion as the free acidity of the sulphuric acid groups was neutralised by the lime in the water. Further experiments on the stability of cellulose acetates confirmed the previous results that neutralised combined sulphuric acid groupings are stable (even on autoclaving at 120° C.).
—B.C.I.R.A.

Hemicellulose-alkali Solutions: Electrolysis. E. Lenoble. *Chimie et Industrie*, 1925, **13**, 128T.

Alkaline solutions of hemicellulose which occur as waste products in the manufacture of viscose were electrolysed. Some of the cellulosic material present in solution is oxidised to carbon dioxide and water, and as the alkali becomes carbonated the remainder becomes less and less soluble and is finally deposited. A possible means of recovering alkali from this waste liquor is thus indicated. —B.C.I.R.A.

Nitrocelluloses: Stability. A. Bréguet and A. Caille. *Chimie et Industrie*, 1925, **13**, 181T-185T.

The authors have studied the question of the stability of nitrocelluloses after washing with (1) natural water containing lime, (2) artificially prepared water containing lime. With natural water it was found that (1) nitrocellulose containing sulphuric acid in the molecule was able to fix the lime in the water; (2) the quantity of lime

fixed depended on the time of washing; (3) the mechanism of stabilisation was explained by an adsorption of calcium bicarbonate by the fibre and the subsequent slow neutralisation of the $—SO_4H$ groups; (4) nitrocelluloses were more stable the more complete was the neutralisation of the sulphuric acid groups. The experimental conditions with artificially prepared water diminished the stability because of excess of lime. —B.C.I.R.A.

Cellulose: Methylation. M. Nierenstein. *Ber.*, 1925, **58**, 2615.

In criticising a statement from Schmid's paper that diazomethane has no action on cellulose, the author calls attention to a partial methylation of a sample of cotton cellulose supplied by Schwalbe effected with diazo-methane by Geake. The resulting products gave methoxyl contents of 1·5-4·2%; the higher values were found in those preparations in which metallic copper was used in the methylation. —B.C.I.R.A.

Viscose Silk: Manufacture. F. Bunzl-Geemen. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 355-357, 403-404.

A fairly detailed description of the viscose process of making artificial silk, from the preparation of the raw material up to the silk winding stage. The methods of spinning by the spooling method and by the centrifugal method are described and the article includes a description of a Siemens-Schuckert electrical spinning centrifuge and the method of using it. —B.C.I.R.A.

Cellulose Crystallite: Dimensions. D. Krüger. *Papier-Fabr.*, (Verein Zellstoff Ing.), 1925 **23**, 767-768).

Measurements of the diameter of the crystallite of nitrated cellulose in acetone solution show that the figure obtained for cotton cellulose exceeds considerably that found for different types of wood cellulose. Also there is a large decrease in the diameter of the particles of ripened viscose as compared with that of the original cellulose. By means of Herzog's diffusion method it is possible to show not only the physical differences between different sized crystallites of various celluloses but also to follow quantitatively the dispersing action of mechanical and chemical agencies. —B.C.I.R.A.

Sulphite Cellulose: Fluorescence. H. Kirmreuther, E. Schlumberger, and W. Nippe. *Papier-Fabr.* (Verein Zellstoff Ing.), 1926, **24**, 106-107.

Unbleached sulphite cellulose exposed to ultra-violet light gives a violet fluorescence which increases in intensity with increasing chlorine consumption number (chlorine used per hour at 20° expressed as percentage of cellulose). By comparing through a light filter the fluorescence of two sulphite celluloses the relative degree of digestion can be determined. Sulphite lyes also exhibit the same fluorescence. After bleaching, the violet colour disappears, giving place to a pale greenish-blue light. —B.C.I.R.A.

Cellulose Acetate and Mercerised Cellulose: Dispersion. R. O. Herzog and D. Krüger. *Chem. Zentr.*, 1926, **1**, 1526 (from *Naturwissenschaften*, 1925, **13**, 1040-1042).

To explain the structure of cellulose the authors have determined, for different types of cellulose in different solvents, the size of the particles at which the cellulose is capable of dispersion. The determinations were made by means of diffusion measurements. The dispersibility in acetone of cellulose acetates prepared from different celluloses and acetylated for different periods of time, begins at a particle diameter of about 20μμ, and in ethyl acetate from 5μμ downwards. In epichlorhydrin the diameter is 35μμ. If cellulose soaked in 17% sodium hydroxide is squeezed out and exposed to the air the size of the particles decreases continually with time. If, however, the cellulose is left in the sodium hydroxide, the particle diameter falls very rapidly to a minimum and then increases again somewhat. Dispersion is, therefore, related to the availability of oxygen and is chemically restricted. —B.C.I.R.A.

Artificial Silk Industry: Development. R. O. Herzog. *Melliand's Tectilberichte*, 1926, **7**, 21-22.

The four methods of manufacture are briefly noted and the increased production of the last few years is indicated. Reference is also made to the manufacture of staple fibre and imitation horse hair and hog's bristles. —B.C.I.R.A.

Artificial Silk: Application. P. Rudolph. *Melliand's Textilberichte*, 1926, **7**, 22.

The possible uses of artificial silk are almost limitless. It can be used for the manufacture of laces and braids, of woven fabrics, of knitted fabrics, stockings, gloves, &c., of embroidered materials, monograms, &c., and in passementerie trimmings. —B.C.I.R.A.

Artificial Silks: Comparison. E. Schülke. *Melliand's Textilberichte*, 1926, **7**, 25-26.

Wet and dry strength figures given by the Bureau of Standards and by Hillringhaus are compared for six viscose silks, Vistra, a cuprammonium silk, two Bemberg silks, Celanese and two other cellulose acetate silks. Fineness figures given by Herzog and extension in moist air, for which figures have been given by Oppé and Goertz, are also considered and the author concludes that acetate silks do not differ essentially from the regenerated cellulose silks and are not superior to them. —B.C.I.R.A.

Adler Silk: Properties. A. Hamann. *Melliand's Textilberichte*, 1926, **7**, 30-32.

Adler silk is a cuprammonium silk spun by a special process of the Bemberg Co. It is an artificial silk of good quality, durability, and washing properties and the lustre is not too metallic. Adler crêpe is a smooth, striped, or checked fabric woven with a crêpe weave. Adler silk is widely used in all classes of fabrics, alone or in combination with cotton. —B.C.I.R.A.

Artificial Silk: Application. F. Müller. *Melliand's Textilberichte*, 1926, **7**, 32-33.

Artificial silk woven fabrics are, in spite of their low cost, more durable than loaded silk fabrics and the author believes it is not improbable that, possibly within a comparatively short time, artificial silk will largely replace natural silk in weaving. With the introduction of suitable sizing methods artificial silk is finding extended use as material for warps. It is used almost entirely in the manufacture of neckties. It has an extensive application in the manufacture of furnishing and upholstery fabrics, and in dress materials, either alone or in combination with wool or cotton. A crêpe-effect dress fabric is shown which is woven with two cotton and two artificial silk threads warp way and weft way.

—B.C.I.R.A.

Cellulose: Constitution; and Cellobiose: Ethylation. K. Hess and G. Salzmann. *Annalen*, 1925, **445**, 111-122.

Viscose: Composition. G. Kita, R. Tomihasa, and S. Iwasaki. *Brit. Chem. Abstr.*, 1926, **45**, B45 (from *Cellulose Ind. Tokyo*, 1925, **1**, 129-134).

The usual methods for the determination of combined sodium and combined sulphur in viscose are considered to be defective. According to the preferred procedure 2 grams of a 6% viscose solution are acidified with 5 c.cs. of 0·5—or 0·25 *N*—acetic acid, and the xanthate is salted out and washed with a neutral saturated solution of sodium chloride. The xanthate is decomposed with 15 c.c. of 0·02 *N*—hydrochloric acid, allowed to stand for four hours, the precipitate is filtered off and washed, and the excess of acid in the filtrate is titrated. The combined sulphur is determined by Carius' method in the xanthate similarly purified. The combined alkali found by this method never exceeds 0·34 mol. per mol. of $C_6H_{10}O_5$. It is lower, the higher the concentration of the caustic soda used for mercerising, the longer the ripening of the alkali cellulose, and the smaller the quantity of carbon disulphide used. When the viscose is matured for a week the proportion of combined sodium does not change very much but increases to a maximum then decreases again. The combined sulphur corresponds with the combined sodium but is always about 10% higher than the equivalent quantity of sodium. The viscosity of the viscose is lower, the lower the proportion of combined sodium and sulphur. —B.C.I.R.A.

Viscose: Properties. G. Kita, R. Tomihisa, and H. Ichikawa. *Brit. Chem. Abstr.*, 1926, **45**, B45 (from *Cellulose Ind., Tokyo*, 1925, **1**, 193-200).

The quantity of sodium combined as xanthate increases with the concentration of the alkali used for dissolving the viscose; it reaches a maximum after the viscose has attained a certain degree of ripening. The viscosity of viscose dissolved in concentrated alkali decreases during ripening and that of viscose dissolved in dilute alkali rises at first and decreases only at a later stage. High alkalinity of the viscose favours the disappearance of the fibrous structure, whilst viscose dissolved in water only always shows fibres. Viscose dissolved in strong alkali gives stronger films; the strength of the film tends to increase with the percentage of combined sodium. In these circumstances the strength of the film tends to increase to a maximum despite the fact that the viscosity gradually falls. The strength of the film from viscose dissolved in water only is poor, although the viscosity is high. Reduction of viscosity by long ripening of the alkali-cellulose, or by mercerising with concentrated sodium hydroxide does not necessarily decrease the strength of the film. Xanthates prepared with small proportions of carbon disulphide always give low values. —B.C.I.R.A.

Alkali-cellulose: Preparation. M. Numa. *Brit. Chem. Abstr.*, 1926, **45**, B9 (from *Cellulose Ind., Tokyo*, 1925, **1**, 87-101).

In the preparation of alkali-cellulose for viscose, the optimum results as regards the viscosity of the viscose solution and the physical quality of the regenerated cellulose are obtained when the steeping is performed under the following conditions—Concentration of sodium hydroxide, 15%; temperature of steeping bath, 20°; time of immersion, 24 hours. The surface area of the sample of cellulose influences the absorption of sodium hydroxide, maximum absorption being obtained with pieces of 0·5-1 sq. cm.; stirring does not influence the absorption. The absorption of sodium hydroxide is increased by the addition of sodium salts, the carbonate having the most pronounced effect and the sulphate the least. The bicarbonate and the phosphate cause a decrease in the absorption. It is suggested that the cellulose does not absorb the undissociated sodium hydroxide molecules, but the sodium ion.

—B.C.I.R.A.

Bamboo and Cotton Celluloses: Comparison. G. Kita and K. Azami. *Brit. Chem. Abstr.*, 1926, **45**, B8 (from *Cellulose Ind., Tokyo*, 1925, **1**, 162-164).

Acetolysis and hydrolysis experiments are quoted to the effect that bamboo cellulose is similar to cotton cellulose. —B.C.I.R.A.

Hydrocellulose, Oxycellulose, and Cellulose Xanthate: Properties. P. Karrer and T. Lieser. *Cellulosechem.*, 1926, 7, 1-6.

Hydrocellulose completely soluble in alkali and having a copper number below 3 is obtained by thoroughly kneading cotton with 84% phosphoric acid at room temperature and, after some hours, heating it at 35°. The hydrocellulose is precipitated from the clear viscous mass by addition of water. By methylation with dimethyl sulphate and sodium hydroxide it takes up a maximum of 43% of methoxyl and the methylated product does not differ from methylated lichenin. It is, like lichenin, more resistant to acetolysis than is cotton cellulose. The alkali solubility of hydrocellulose depends on peptisation or on the formation of an addition compound with the alkali hydroxide. Conductivity experiments were insufficient to decide between the alternatives. The acid character of oxycelluloses affords a means of differentiating them from the hydrocelluloses. The test is conveniently expressed in terms of "acid number," which is the number of c.cs. of normal alkali hydroxide taken up in the titration of 1 gram of the substance in the presence of phenolphthalein. Hydrocelluloses do not take up alkali. Hydrocellulose prepared by means of phosphoric acid gives, like cellulose and unlike oxycellulose, no isosaccharinic acid when boiled with lime. Cellulose xanthate solutions can be purified by dialysis. A colourless, alkali-free solution is obtained in less than eight hours. Analysis of solutions dialysed as rapidly as possible showed two sulphur atoms and two or less than two sodium atoms to $2C_6H_{10}O_5$ residues. The dialysed solution shows the Brownian movement; under the influence of an electric current the compound is decomposed into its constituents, sulphur-free cellulose separating at the anode. Addition of metallic salts produces characteristic colours which differ somewhat from those produced with viscose solutions. The methyl ester of the xanthate is a very unstable compound having a characteristic odour. Experiments with the xanthate of lichenin gave analogous results. The composition of a rapidly dialysed solution was almost the same as that of the dialysed viscose solution. The methyl ester had an analogous odour and the metallic salts gave the same colours. —B.C.I.R.A.

Viscose: Theory of Preparation. E. Heuser and M. Schuster. *Cellulosechemie*, 1926, 7, 17-55.

Previous theories are reviewed with particular attention to that of Cross, Bevan, and Beadle, and the authors' work is discussed under the following sections—

Ripening—In the series of xanthates separated during ripening by precipitation of the viscose solution with alcohol, the cellulose, sodium, and sulphur contents were determined and the intermediate steps were found to be less sharply defined than Cross, Bevan, and Beadle had stated. This may be due to adsorption of sodium hydroxide by the alkali-cellulose and since it leads to variable results, it was decided to make the experiments on soda-free xanthates. These were precipitated from the viscose solution by dilute acetic acid and a saturated solution of sodium chloride. The whole of the xanthate was precipitated, washed with alcohol, and dissolved in water. The xanthate was re-precipitated with alcohol at various stages of ripeness. The intermediate steps were now more sharply defined and ripening was more rapid. The results show that ripening is a conversion of the original xanthate into compounds rich in cellulose, as stated by Cross and Bevan. It proceeds readily to the C_{24} compound, but after this point is very slow, and passes through a very large number of intermediate steps before pure cellulose is obtained. The highest xanthate analysed contained 96·1% of cellulose, the formula corresponding to 94·3% of cellulose containing ten $C_6H_{10}O_5$ units. Coagulation does not coincide with the presence of pure cellulose; in an advanced state of coagulation the coagulate is a mixture of a very far ripened xanthate and pure cellulose. Cellulose xanthate is hydrolysed by acids and alkalis to cellulose, carbon disulphide, and sodium hydroxide, and this reaction may be employed to follow the process of ripening since with increasing degree of ripeness the xanthates give progressively less carbon disulphide. Viscose is slowly decomposed by carbon dioxide, but the reaction proceeds so slowly that in technical processes atmospheric carbon dioxide can hardly have any effect on the viscose. Viscose solutions containing 8-9% of free alkali show the greatest stability and lowest viscosity.

Chemical Combination of Cellulose and Alkali as the Basis of Formation of Xanthates—Four viscoses were prepared having the same cellulose content and respectively 4·5, 7·0, 11·0, and 14·0% of sodium hydroxide. Two series of xanthates were precipitated after one and seven days respectively. Sodium estimations show that the sodium content of the xanthates increases with increasing alkali concentration of the viscose. This would appear to suggest adsorption of excess alkali rather then chemical combination, but the conditions of experiment were such that the suggestion must be accepted with reservation. The formation of the xanthate depends on the formation of the alkali-cellulose compound $(C_6H_{10}O_5)_2NaOH$ and there is no production of viscose if the concentration of the mercerising alkali does not allow this compound to be formed. The minimum concentration of sodium hydroxide in which the compound $(C_6H_{10}O_5)_2NaOH$ can be formed is 16% by volume. Photo-micrographs

show that at this concentration the fibrous structure of the cellulose disappears and the formation of xanthate begins. Well-defined xanthates giving rise to viscoses are similarly obtained from the compounds of cellulose with lithium, potassium, and rubidium hydroxides, the critical concentrations of the hydroxides being respectively 9, 35, and 38%. As in the case of sodium hydroxide these concentrations are those at which a point of inflection occurs in the curve, showing the relation between concentration of alkali and its absorption by cellulose. Series of photo-micrographs of the viscoses from alkali-celluloses prepared with varying concentrations of these alkalis are reproduced. These show that, although xanthate formation begins at the concentrations quoted, a definite excess of alkali is always required for complete solution, namely, 2-3% by volume of lithium hydroxide, 4-5% of sodium hydroxide, 5-6% of potassium hydroxide, and 10% of rubidium hydroxide, making total concentrations required for the formation of the alkali-cellulose compound of 11-12%, 20-21%, 40-41%, and 48% respectively. In this connection it is shown that the solubility of the xanthates in alkali hydroxides falls with increasing atomic weight of the alkali metal. Caesium hydroxide in *N*-solution has no solvent power for xanthates, and *N*-rubidium hydroxide is only slightly better. Viscose is only produced from the rubidium hydroxide-cellulose compound when this has the constitution $(C_6H_{10}O_5)_3RbOH$. Xanthates prepared from lithium and rubidium celluloses were isolated and shown to be true xanthates.

Relation between Composition of the Xanthate and Quantity of Carbon Disulphide Employed—Since the soda-cellulose from which the xanthate is formed has the composition $(C_6H_{10}O_5)_2NaOH$, the xanthate must contain two cellulose residues as against the single $C_6H_{10}O_5$ unit stipulated by Cross and Bevan, and di- and tri-xanthates do not exist. This has been confirmed experimentally, the authors having been unable to isolate a C_6 product; the first xanthate formed is a C_{12} product. Herzog's contention that the sulphur content of the xanthate increases with increased duration of the sulphiding process is disproved and attributed to the lack of purification of the xanthates employed. A series of experiments was made on the formation of xanthates in the presence of limited quantities of carbon disulphide, and it is shown that true xanthates giving normal viscoses are obtained with less than 1 mol. carbon disulphide to one $C_6H_{10}O_5$ group—the proportion stipulated by Cross and Bevan, and that the xanthate formed depends on the quantity of carbon disulphide applied. Moreover, ripening proceeds more rapidly as the quantity of carbon disulphide used is decreased. This is traced to the instability of the C_{12} product in the presence of a very small excess of carbon disulphide, and its tendency to pass rapidly to the more stable C_{18} and C_{24} forms. The presence of by-products decreases the stability of viscose solutions in direct proportion as their quantity increases. The experiments were made with trithiocarbonate, the chief by-product formed.

Changes in the Cellulose during Ageing, Sulphiding, and Ripening—During the ageing of the alkali-cellulose and in the sulphiding process the cellulose complex is broken down to smaller molecular aggregates, but in the ripening process it suffers practically no further change. These statements are based on changes in the viscosity in cuprammonium solution of cellulose regenerated at various stages of the different processes.

Changes in the Viscosity of the Viscose Solution during Ripening—The viscosity of a viscose solution falls to a minimum, rises again slowly, and shortly before coagulation increases suddenly. These changes were studied in a 2% viscose solution. The fall in the viscosity of the freshly prepared solution is traced to colloid-chemical changes in the solution and the subsequent rise to the accumulation of free salts, chiefly sodium carbonate and trithiocarbonate, during ripening.
—B.C.I.R.A.

Spun Artificial Silk. E. Lehmann. Kunstseide, 1926, 8, 15-17.
A general article on spun artificial silk, a fibre of definite length likely to come into more general use in admixture with other fibres on account of cheapness. The Köln Rottweil A.G. makes Vistra of four types; Type I in filaments of 1-1·5 den., which can be spun to schappe-like yarns of 2/200's, Type Ia of 1·5-2·5 den. giving linen-like yarns of 50's, Type II giving worsted-like yarns, and Type III, of 3-4·5 den., giving Cheviot-like yarns. The Zellstoffabrik Zehlendorf G.m.b.H. is making a spun thread called "Spinstro" by the cuprammonium process. —B.C.I.R.A.

Viscose Silk: Manufacture. H. G. Dahlenvord. *Melliand's Textilberichte,* 1926, 7, 56-60.
A general account of the processes of viscose silk manufacture in which particular attention is drawn to the practical and mechanical conditions necessary in each process for the production of a good yarn. —B.C.I.R.A.

Cuprammonium Silk: Manufacture. W. R. Roederer. *Melliand's Textilberichte,* 1926, 7, 48.
A short article on the manufacture of cuprammonium silk by the stretch spinning process. The commercial success of

cuprammonium silk is attributed to the introduction of this process as the stretching influences the properties of the material. Thus, very fine filaments are obtained resembling the natural fibre in structure and properties. The loss of strength of cuprammonium silk on wetting is very low and it therefore finds considerable application in the manufacture of washing silks. Some patterns of striped washing fabrics woven entirely from cuprammonium silk are included. —B.C.I.R.A.

Cuprammonium Silk: Manufacture. W. Hahnke. *Melliand's Textilberichte*, 1926, **7**, 38-40.

A general account. —B.C.I.R.A.

Viscose Staple Fibres. E. Schülke. *Melliand's Textilberichte*, 1926, **7**, 36-38.

Lanofil is a viscose staple fibre especially prepared for mixing with wool. Other viscose staple fibres for the same purpose are Vistra, "Woolulose," said to be an English product, and Sniafil. Sniafil is also made in a form suitable for mixing with cotton. Fabrics made from a mixture of wool and artificial wool are stronger than those of pure wool, have a pleasanter feel and better wearing properties. Photomicrographs are reproduced showing a staple fibre produced in 1920, a newer type of staple fibre, and Lanofil. The 1920 product has a smooth glassy surface and therefore is bad for spinning. In the more recent product the surface is broken by a number of small scars which confer better spinning properties, whilst the surface of the Lanofil fibre has deep lateral furrows which fix the twist in spinning. Staple fibre may also be prepared by the cuprammonium process. —B.C.I.R.A.

Artificial Silk: Bacterial Decomposition. A. C. Thaysen and H. J. Bunker. *Bio. Chem. J.*, 1925, **19**, 1088-1094.

A preliminary investigation of the rate of decay of artificial silks by micro-organisms is reported. Three series of exposure tests were made in which samples of each of the four main types of artificial silk were (1) incubated at 37° in a suitable medium inoculated with a culture containing anærobic cellulose decomposing bacteria, (2) buried in a light garden soil, and (3) submerged in sea water. Cellulose acetate silk showed the greatest resistance to micro-biological destruction. The other types showed a varying resistance, the order being nitro, viscose, and cuprammonium silk. The possible causes of this difference are discussed. —B.C.I.R.A.

Cuprammonium Silk Raw Materials: Recovery. W. Hahnke. *Melliand's Textilberichte*, 1926, **7**, 40-41.

Copper is recovered from the sulphuric acid baths containing copper salts by continuous electrolysis. Ammonia may be recovered as ammonium sulphate or as ammonia solution. The author prefers the latter method and describes a convenient recovery apparatus in which the ammonia is led in at the bottom of a double-walled vessel, passes up between the walls, thence down a central pipe to a water chamber. Unabsorbed ammonia then passes to the top of the apparatus through a series of similar water chambers. —B.C.I.R.A.

Patents

Artificial Silk Spinning Apparatus. M. Klavik, Dobrichovic, near Prague. E.P.247,172.

The parts of the spinning apparatus are arranged so that the filaments extruded from the spinning nozzle into the coagulating bath travel vertically to the godet and then fall vertically into the centre of the centrifugal box. The edges of the godet are chamfered off in order that any filaments that may wrap round the godet are more easily removed. —B.C.I.R.A.

Wood Pulp Mercerising Apparatus. J. Brandwood, Birkdale, Southport, Lancs. E.P.247,307.

Apparatus for impregnating wood pulp with liquids without handling, comprises a tank through which the pulp is carried by means of a conveyor, and a press over which the conveyor passes, the press-plate being adapted to descend on to the layer of pulp at intervals, at which times the motion of the conveyor is automatically stopped. The apparatus is particularly applicable to the treatment of wood pulp with alkalis in the manufacture of artificial silk. —B.C.I.R.A.

Artificial Silk Spinning Pumps. E. Lunge and Courtaulds Ltd., London. (1) E.P. 248,042; (2) E.P.248,043; (3) E.P. 248,046.

(1) In a plant for spinning artificial silk the plungers of the pumps are mounted on a horizontal bar provided with a cam-surface adapted to engage on abutments traversed longitudinally with respect to the row of pumps; the abutments are traversed by right and left-handed screws on a common shaft. The bar forms part of a rectangular frame, the opposite member of which is guided by a pin working in a slot. Positive operation in both directions may be provided, either by means of two separate cam frames or by two oppositely-directed members of one frame.

(2) The moving parts of the control pumps of an artificial silk spinning plant are immersed in a bath of liquid such as will prevent the formation of a coagulated viscose film and which may serve as a lubricant for the parts in question; suitable liquids are solutions of caustic soda and sodium carbonate, and the surface of the liquid is protected from contact with the air by a layer of oil. The temperature of the liquid is controlled by means of

heating or cooling pipes passing through the bath. The supply pipe for conveying the spinning solution to the nozzles is also jacketed so that the temperature and therefore the ageing process may be controlled.

(3) Viscose solution is delivered from a number of outlets to spinning nozzles, conduits being arranged to form a closed circuit, from which all the outlets are supplied. The solution is circulated continuously round the circuit at a speed higher than that produced by the rate of flow from the outlets. The arrangement of cam-driven pumps employed is described. —B.C.I.R.A.

Preparation of Artificial Fibres—

247,979. Pathé Cinema. Artificial filaments and threads from cellulose nitrates, acetates, or other esters.

247,044. E. Lunge and Courtaulds, Ltd. Filter for viscose liquids.

247,045. E. Lunge and Courtaulds, Ltd. Air vessel design for viscose pump.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Scutcher Lap Regularity Indicator. J. Tschudy. *Leipz. Monats. Text. Ind.*, 1925, **40**, 464-465.

The device traces a record on a revolving drum. —B.C.I.R.A.

Fatty Acid Esters: Application. —. Welwart. *Chem. Zentr.*, 1926, **i.**, 791 (from *Seifensieder. Ztg.*, 1925, **52**, 861.)

The application of synthetic fatty acid esters as oiling materials for textile fibres is advocated. Waste fatty acids from oil refining should be converted into ethyl esters. Cotton seed fatty acids are not appropriate because of the spontaneous inflammability of fibrous substances associated with them. —B.C.I.R.A.

Weft Spool Winding Machine. R. Neumann. *Melliand's Textilberichte*, 1926, **7**, 137-138.

A new type of weft spool for ribbon looms is cross-wound and has sloped ends. The spools are wound on machines provided with automatic means for shortening the winding length with increasing diameter of the spool. A winding machine of this type, but simple in construction and reasonable in cost, has recently been constructed by the Maschinenfabrik Schweiter A.G. Small cross-wound spools, such as are used in embroidery, can be wound on this machine. —B.C.I.R.A.

Blow-room Pneumatic Conveyors. E. Blau. *Melliand's Textilberichte*, 1926, **7**, 122-123.

A typical modern pneumatic conveying, mixing, and dust removing system for cotton is described. The advantages of a system of this kind are—Cottons of different kinds are well mixed giving a uniform blend. The air currents to which the cotton is subjected loosen it so that it is presented to the beaters and cards in a lighter form. There is practically no loss of fibre since pipes and mixing chambers are airtight. The bale breaker can be erected without reference to the position of the mixing rooms, since the cotton can be carried any distance and to any height. A plant of this type economises labour considerably and reduces fire risks. —B.C.I.R.A.

(B)—Spinning and Doubling

Roller High Draft Mechanisms. F. Engelmann. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 425-427.

The author discusses the Toeniessen roller high draft mechanism in comparison with his own design. Both are four cylinder systems with the plane of the drawing field broken but the Toeniessen system lays stress on the important function of the lower middle cylinder in giving a negative draft. A table showing roller distances and percentages of hairs overlapped for the newer high draft mechanisms is distinctly in favour of the short roller distances of the Toeniessen system. —B.C.I.R.A.

Mule Frame Guide Rail: Curvature. O. Thiering. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 465-467.

A mathematical determination of the form of curve to which the guide rail of a self-acting spinning frame is built. Both ascending and descending sections are parabolic in form. —B.C.I.R.A.

High Draft Systems. M. Lehmann. *Leipziger Monats., Text.-Ind.*, 1926, **41**, 1-4.

A general article on high draft systems with a special plea for a fluted cylinder system which is capable of drawing fibres of very different staple lengths (mixtures of cotton and wool, &c.). The advantages of this system are enumerated. —B.C.I.R.A.

Cop-building Eccentric: Design. F. Kastner. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 16.

The theory of forming a stable cop with parallel sides and tapering ends for ring and spinning machines is explained and also the method by which the eccentric is designed from the shape of the cop desired. Owing to the compression of the under layers of yarn and the varying tensions, the eccentric designed on the theoretical principles has in practice to be formed by hammering and filing until it is of the shape required by the spinner. —B.C.I.R.A.

Mule Yarn: Control of Snarling. A. Seibt. *Melliand's Textilberichte*, 1926, **7**, 4.

Conditions to be maintained in order to prevent snarling on the mule frame are discussed. —B.C.I.R.A.

Self-doffing Flyer Spinning Frame for Worsted. J. & T. Boyd, Ltd. *Text. Mfr.*, 1926, **52**, 53-54.

In this frame doffing is effected simply by turning the spindle plate through 180°. A few coils of yarn are then wound from the full to the empty bobbins and finally the ends are cut by a patented mechanism and spinning is restarted. The whole operation takes only 30 seconds. The frame can spin at speeds 50% higher than normal and is being adapted for all kinds of textile fibres. —L.I.R.A.

Vanni High Draft Mechanism. *Melliand's Textilberichte*, 1926, **7**, 137.

A brief account of the essential mechanism of the Vanni high draft system. —B.C.I.R.A.

(C)—Subsequent Processes

Reeling Frames: Yarn Paraffining Device. W. Binder. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 251-252, 295-296.

A review of the newer types of reeling frames and swifts built by the Maschinenfabrik Schweiter A.-G. Two types of yarn paraffining apparatus are also described. —B.C.I.R.A.

Tubular Cops: Winding. A. Schulze. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 5.

The conditions to be fulfilled to minimise waste when winding a tubular cop for use on a spindle or in a shuttle are discussed. The use of a small hook to replace the weaver's knife for drawing out the starting end of the thread is advocated. —B.C.I.R.A.

Patents

Card Stop Motion. J. B. Santos. U.S.P. 1,559,282 (from *Text. World*, 1926, **69**, 2745).

The device automatically stops a card when the sliver passing between the calender rollers falls below a standard weight. It consists of a lever arrangement which throws a gear in the doffer driving train out of mesh when the top calender roller drops a sufficient distance. —B.C.I.R.A.

Yarn Spraying Apparatus. C. Brühl & Co., Rheydt, Germany. E.P.246,471.

In means for spraying yarns, &c., to moisten them after spinning by spraying them layer by layer with a certain quantity of water, an adjustable container including a diaphragm which moves alternately from one position to another is used to deliver a definite quantity of water to the spraying nozzle at each stroke of the diaphragm. A four-way cock in one position admits water by a tube to the underside of a diaphragm which in rising against a perforated plate expels a definite quantity of water through a tube and the cock to the spraying nozzle. For spraying the next layer of yarn, &c., the cock is turned over and admits water to the upper side of the diaphragm, which in moving against the perforated plate, delivers the same quantity of water through the cock to the nozzle. The quantity of water delivered is varied by adjustment of the plate by means of a screw connected to an indicator. —B.C.I.R.A.

Carding Engine. C. Gegauff, Mulhouse, Haut-Rhin, France. E.P.246,499.

In order to sort out the shorter fibres from the fleece of cotton or analogous material prepared on the carding engine before it is passed to the calender rollers and formed into a sliver, a drum is provided which acts with the doffer or the cylinder. The fibres are spread as a thin fleece on the drum and the shorter fibres are thrown off by centrifugal force into a suitable receptacle, whilst the longer fibres are carried forward and formed into the sliver. The speed of rotation of the drum will govern the length of the fibres thrown off. The drum may be clothed with wire or bristles and may be arranged below the doffer, or so as to act on the fibres on the main cylinder before they reach the doffer. —B.C.I.R.A.

Roller Drafting Mechanism. F. Ferrand, Southport, Lancashire. E.P.246,530.

The positively driven rollers of the drawing mechanism of machines for preparing and spinning yarn are mounted eccentrically on their journals, or are provided with one or more cam-like parts so as to exert a continuously or intermittently varying draft, and are arranged so that when one line is exerting an increasing or increased draft the adjacent line or lines are exerting a decreasing or decreased draft. —B.C.I.R.A.

Ring Traveller: Manufacture. P. Wentworth, Providence, R.I., U.S.A. E.P. 246,600.

Ring travellers of the type described in Specification 174,068, are made by intermittently feeding ribbon-like strip by feed-rolls, first under a punch by which a central aperture is punched in the strip and secondly under a reciprocating bender which, coacting with a fixed cutter, severs the strip and bends the ring blank so formed round a mandrel. Pivoted benders are then operated to complete the bend, after which the mandrel is withdrawn laterally to allow the ring traveller to fall. Details are given of the punching and bending mechanism. —B.C.I.R.A.

Drawing Roller Head. Le Blan et Cie and M. A. Roth, Lille, Nord, France. E.P. 246,782.

In a modification of the roller head described in Specification 233,835, the operative surfaces of intermediate rollers

and the guiding rollers are milled. An intermediate support may be used, so that the top rollers may be made in two independently weighted portions to increase the regularity of the draft. —B.C.I.R.A.

Lubricants for Wool Fibres. I. G. Farbenindustrie A.-G., Frankfort-on-Main, Germany. E.P.246,867.

Sulphonic acids obtained by condensation of benzyl chloride with naphthalene, or tetraline, or of naphthalene and "tall" oil, both with a sulphonating agent, or in one of two other ways specified are used for the stabilisation of such emulsions as "softening oil," "spinning oil," or "spike oil." Examples of quantities used are given. —H.L.R.

Cotton Cleaning and Mixing Machine. Howard & Bullough, Ltd., and J. Bancroft, Globe Works, Accrington, Lancs. E.P.247,079.

In an arrangement for cleaning and mixing cotton by pneumatic means, in which the cotton from bale openers is passed through dust trunks and a conduit to one or other of a series of chambers by a blower, each chamber is provided with a pivoted flap valve, whereby excess air pressure within the chamber is relieved. Air and dust are withdrawn from the chambers through a pipe by a fan and are passed to a filtering chamber, which is divided by gauze partitions into vertical and horizontal planes so that the air traverses a tortuous passage. Dust falls into a box at the base and the air escapes by an outlet. Gauze or otherwise protected fans may be used in the chambers to assist in agitating and mixing the fibres. —B.C.I.R.A.

Spinning Machine Flyers. Rockwood Sprinkler Co., Worcester, Mass., U.S.A. E.P.247,082.

Flyers for spinning machines are made from a sheet metal blank one end of which is rolled to form the balance rod, whilst the other end is first rolled out to a tapering form having flat portions separated by a concavo-convex portion, the flat portions being subsequently bent up to form a continuous curve with respect to the concavo-convex portion, to form the thread guide. —B.C.I.R.A.

Flyer Frame Electric Stopping System. Bergmann - Elektricitäts - Werke A.-G., Seestrasse, Berlin. E.P.247,192.

Means are provided in flyer spinning machines for stopping the machine with the flyers arranged in the required position for threading the roving. An electro-magnetic switch in the circuit of the driving electric motor is provided with a contact for a circuit of a magnet coil, and the circuit of the coil is so arranged that, when a second contact is placed in a certain position by means of a rod, the switch is alternately opened and closed by reason of the closing and opening of the circuit of the coil by the first contact. When the flyers are in the desired position a cam on the flyer-driving shaft or on a flyer spindle operates the rod so that the second contact is in its mid-position. The machine operates normally with the second contact in position so that the coil is energised. The automatic stopping of the machine when the flyers are in position may be effected by an auxiliary contact, instead of by the movement of the rod, and two separate switches may be used in place of a single throw-over switch so arranged as to prevent both being actuated at the same time. —B.C.I.R.A.

Ring Frame Driving Mechanism. A.-G. Brown, Boveri et Cie., Baden, Switzerland. E.P.247,208.

In electrically driven ring spinning and doubling frames in which cams operate a system of levers connected to the regulator of the motor, and respectively impart to it the motions necessary to give the speed variations corresponding to the reciprocation and to the translation of the ring rail, devices are embodied in the lever mechanism by which the motions imparted by the cams may be varied during the operation of the frame. —B.C.I.R.A.

Combing Machine. Fine Cotton Spinners and Doublers Association, Ltd., and J. Hindley, Manchester. E.P.247,332.

In a combing machine of the Heilmann, Nasmith, or like type, in which the detaching is performed by a pair of nippers, a top comb being brought into action near the point where the fibres are nipped for detaching, the detaching nippers comprise an horizontal lower jaw and an approximately vertical upper jaw pivoted on trunnions and operated by a cam on a shaft driven from the cylinder shaft through gearing carried by pivoted links. The lower jaw is operated by a cam on the shaft and is provided with an incline on which lies loosely a leather-covered roller, so as to rest against the inner leather-covered face of the upper jaw. When this jaw descends it rotates the roller and forces it back along the lower jaw, causing it to feed forward the tuft of fibres which have been previously combed. —B.C.I.R.A.

Drawing Frame. E. W. Barnett and Ashton Bros. & Co., Hyde, Cheshire. E.P.247,480.

One or more pairs of additional calender rollers with their associated trumpets are provided between the last pair of drawing rollers and the usual calender rollers above the coiler can, and are driven from the same shaft as the latter rollers. —B.C.I.R A.

Spinning Frame Flyer Pressers: Manufacture. Rockwood Sprinkler Co., Worcester, Mass., U.S.A. E.P.247,486.

A method is described of making pressers such as are ordinarily used on flyers on a spinning frame entirely by a series of die-pressings. —B.C.I.R.A.

Ring Travellers: Manufacture. P. Wentworth, Providence, R.I., U.S.A. E.P. 247,645.

Ribbon-like strips are intermittently fed by feed rolls first to a milling cutter which scallops the edges of the strip and secondly to a reciprocating semi-circular bender which severs the strip and partly bends the blank round a mandrel, after which pivoted benders complete the ring traveller. The strip stock is made by rolling wire. The feed mechanism and the design of milling-cutter are described. —B.C.I.R.A.

Flyer Frame Winding-on Motion. F. Raubitschek, Rybarpole, Czecho-Slovakia. E.P.247,651.

A mechanism is described for providing flyers and spindles in flyer frames with self-contained means to effect the necessary difference in speeds for winding-on. The device comprises a single oblique groove in the spindle or flyer and a vertical slot in the other through which a reciprocal pin passes and engages the oblique groove. —B.C.I.R.A.

Spindle-driving Apparatus. Clark & Co. and D. M. McLintock, Anchor Thread Mills, Paisley. E.P.247,708.

A spinning or doubling frame in which the spindles are driven by a tape is so constructed that the tape can be woven or otherwise formed endless before being applied in place upon the machine. Each of the tapes has a free loop passing down between the tin rollers and receiving a weighted jockey pulley carried on an arm fixed by a pin in a hole in the framework. The method of reversing the drive is shown. The frictionally-driven tin roller can be replaced by a further set of jockey pulleys or in the other ways specified. —B.C.I.R.A.

Sulphonated Wool Fat Emulsions. O. Herzog, Faradayweg, Dahlem, Berlin. E.P.247,714.

The waxy and liquid fractions obtained from wool fat are sulphonated separately. The hard fat is obtained by cooling a saturated solution of wool fat in acetone or benzine, and the soft fat is then obtained by fractionation in vacuo at 10° C. Stable emulsions miscible with large quantities of water are obtained by treating the sulphonated products with alkalis and organic solvents. —H.L.R.

Bobbin Creel Stay. A. Brown, J. Speak, and Tweedales & Smalley, Ltd., Castleton, near Manchester. E.P.247,755.

The stays of the bobbin creels of spinning and twisting machines are formed of metal and are provided with dovetail portions, and the brackets are formed with a lug to engage a dovetail portion and with a straight lug for a clamping screw, so that they automatically bed firmly against each other. —B.C.I.R.A.

Mule Spindle Oiling Device. H. Cocking and others, Vernon Brass Works, Stockport, Cheshire. E.P.247,812.

Inclined oiling holes lead into the bolsters from a grooved lug which serves as a distributor for the oil when the bolsters are mounted on the rail by the attachments described. The oiling holes are situated near the tops of the bolsters which stand above the groove in the lug. The bearing hole is provided with an annular groove to reduce upward creeping of the oil. —B.C.I.R.A.

Spinning Frame Flyer. Rockwood Sprinkler Co., Mass., U.S.A. E.P.247,836.

The flyers are made from die-pressed sheet metal in order to obtain them exactly similar and so avoid the necessity of balancing. A cylindrical bearing stem is pressed out so as to have a tapering inner passage, the top is drawn in and perforated and an opening is formed in the side. The crown is formed with solid sloping arms, one of which has a thread-guiding groove, the upper sides being flat and the lower convex to present stream line surfaces. Three cylindrical bosses serving respectively as a hub for the bearing stem, for carrying a solid balancing arm and a hollow roving guide are made in one piece with the crown in the pressing process. —B.C.I.R.A.

Spinning Ring. G. Reinhold, Selbitz, Oberfranken, Germany. E.P.247,848.

Rings for spinning and twisting machines are provided with a steel band to afford a bearing surface for the traveller. The steel part is lined and jacketed with non-corrosive material to prevent rusting. —B.C.I.R.A.

Bobbin Thread Clasp. C. A. Clitherow, Maida Hill, London. E.P.247,882.

A device for preventing unwinding from a flanged reel or bobbin and for tensioning the thread consists of a wire bent into the form of three sides of a rectangle and connected at the open ends by short springs to two wires which pass across the bobbin ends and are bent at right angles to fit into the hole of the bobbin. The first wire thus rests resiliently on the thread. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Preparatory Processes—

246,611. H. S. Brooks. Carding engines; pulley for——.

246,916. J. Cook. Rotary scutching machine for sisal, jute, hemp, &c.

247,478. Fine Cotton Spinners and Doublers Association. Combing machine: holding-nippers device.

247,701. T. Barbour and M. M. Waddell. Bundling apparatus for flax, &c.

247,979. E. Fievet. Oscillating grid for heckling machine.

Spinning and Doubling—

247,263. T. Barbour. Rope Spinning machine: bobbin speed control.

247,421. J. & T. Boyd, Ltd. Thread severing device.

3—CONVERSION OF YARNS INTO FABRICS

(A)—PREPARATORY PROCESSES

Jacquard Cords: Tying. J. Funke. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 292-295.

An article giving directions for tying the neck cords of a Jacquard. —B.C.I.R.A.

Weft Winding Machine. R. Voigt Co. *Melliand's Textilberichte*, 1926, **7**, 19-20.

The machine rewinds grey and coloured yarns from cops, bobbins, &c., on to suitable foundations for weft cops. The circular construction was adopted to enable a rotating yarn feed to be used simultaneously for a large number of spools. The machine shown has 20 winding spindles. It produces very hard, cross-wound spools containing a large amount of yarn and very high production is claimed for it. —B.C.I.R.A.

(B)—SIZING

Starch: Constitution; and Phosphatases: Action on Starch. —. Samec. *Compt. rend.*, 1925, **181**, 532-533.

Enzymes capable of hydrolysing phosphoric acid esters were found to act similarly on potato starch and on synthetic amylophosphates, giving in both cases free phosphoric acid and a dialysable organic compound containing combined phosphoric acid. The results lend support to the theory that a part of the amylaceous constituent of the starch grain exists in the form of a phosphoric acid ester. —B.C.I.R.A.

Starch: Hydrolysis. M. Braun. *Chem. Zentr.*, 1925, **i.**, 2669 (from *Ann. de la science agronom. franç. et étrangère*, 1924, **42**, 352-358).

The author hydrolyses the starch with diastase solution to which he adds 4% potassium chloride. As antiseptic he uses 0·25% phenol or formol (15 c.c. to 10 litres liquid). In this way he is able to employ a temperature of 40-41°, which is much below the temperature injurious to diastase (70°). Hydrolysis is complete in 36 hours. —B.C.I.R.A.

Paperine: Application. E. Tromp. *Papierfabrikant*, 1925, **23**, 109-111.

Paperine is a starch product consisting of white, somewhat transparent granules, soluble in 20 parts of cold water giving a neutral solution. Complete solution in cold water requires some hours but solution is effected in a few minutes by heating a cold water suspension. Comparative experiments on the properties of papers sized and loaded with rosin, kaolin, and Paperine, and with rosin, kaolin and potato starch, show that Paperine retains more rosin in the paper than potato starch and gives better results even when used in only one-third the quantity of the starch. The resistance to folding, tearing strength, and tearing length of the paper are improved by the addition of Paperine. —B.C.I.R.A.

Paper: Sizing. E. Öman. *Papier-Fabr.* (Verein Zellstoff Ing.), 1926, **24**, 49-58.

The author investigated the action of alum on wood cellulose and the absorptive power of the latter for rosin. Using ash-free filter paper and bleached, disintegrated sulphite cellulose, he found that aluminium is taken up by the fibre in exchange for potash, and that aluminium so taken up can be transferred to fibres which have not previously taken up aluminium. Rosin can be taken up by the fibre in water in the absence of alum but the amount taken up is dependent largely on the degree of dispersity or the charge possessed by the rosin. —B.C.I.R.A.

Artificial Silk Sizing Problems. W. B. Crompton. *Text. Mfr.*, 1926, **52**, 133.

The sizing of artificial silk requires a special machine owing to the marked expansion and weakening which occur in wetting and the corresponding contraction and strengthening which take place on drying. Such a machine has been produced by Messrs. Walker & Sons, Ltd., Radcliffe, and is described in the article under notice. —L.I.R.A.

Starch Grains: Swelling Temperature. W. Arzichowski. *Chem. Zentr.*, 1925, **i.**, 2543 (from *Bull. Acad. St. Petersbourg*, 1918 (6), 349-368).

For estimating the temperature of swelling of starch grains in water a starch suspension composed of grains as far as possible of equal size is maintained for two hours at a constant temperature and the number of unswollen, half and completely swollen grains noted. Those grains which show simultaneously weak and strong double-refracting areas are designated "half-swollen." Three series of investigations were carried out involving the counting of some 200,000 grains. Swelling begins at about 55°, at 67°·5 nearly all the grains are swollen. The average temperature for complete swelling is 60°·97 ± 0·10. Variations from this average value only approximately follow Gauss' law of error; the number of swollen grains—temperature curve is too asymmetric. No evidence, however, of the existence of two kinds of starch was found. —B.C.I.R.A.

Starch: Adsorption and Moisture Relations. A. Rakowski. *Chem. Zentr.*, 1925, **ii.**, 532 (from *J. Russ. Phys. Chem. Ges.*, 1915, **47**, 1326-1329).

Van Bemmelen's observation that the disintegration of hydrated substances does not influence the rate of water evaporation from the substances indicates the great mobility of the water in the substances which contain it in the state of absorption. This increased mobility is clearly apparent if dehydration of dilute sulphuric acid is carried out by the van Bemmelen method since, for the same vapour pressure difference, sulphuric acid loses its water much more slowly than starch. —B.C I.R.A.

(C)—Weaving

Electro-Magnetic Looms. *L'Avenir Text.*, 1925, **7**, 589-595.

The article describes the application of electro-magnetic induction to the operation of the moving parts of looms. The mechanism for driving (1) the cloth and warp beams, (2) the lay, (3) the leaves, and (4) the shuttle in both single and multiple shuttle looms is described. —B.C.I.R.A.

Automatic Weft-changing Mechanisms: Review; and the Schönherr Loom. F. Kastner. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 79-82.

An analysis of the various types of automatic weft-changing mechanisms in use and their particular applications. The major part of the paper is devoted to a detailed description of the Schönherr loom in which the bobbin enters the shuttle vertically from below and the empty case is ejected upwards. —B.C.I.R.A.

Eccentric Dobby. A. Schweizer. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 249-251.

An eccentric dobby constructed by the firm Gebr. Stäubli & Co. is described which permits of an open shed condition persisting for the maximum possible time, namely, for one-third of the time of a complete motion of the dobby. The principle and method of driving of the dobby are described. —B.C.I.R.A.

Ribbon Looms. F. Klages. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 334-336.

An article dealing with the construction of ribbon looms generally, with a more detailed description of cloth beam adjusting devices. —B.C.I.R.A.

High Efficiency Ribbon Loom. F. Lüdorf and Co., G.m.b.H. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 341.

A new ribbon loom designed as regards dimensions and speed to meet the conditions found in practice to be the best. The loom has an inside length of 2 metres and the moving parts and the shuttle are operated by powerful cam discs whereby vibration or impact is avoided in spite of the comparatively high speed of the loom (240 picks per minute). —B.C.I.R.A.

"Horn" Braiding Machine. Guido Horn Maschinenfabrik. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 342-343.

A new braiding machine of the "Schnellflechtmaschine" type is described. Half the number of creels are mounted on the underside of a revolving disc while the remaining creels are fixed in a circle above the revolving disc. Between the upper creels are placed toothed gear wheels through the axes of which are thread guides to carry the thread from the lower creels. From both sets of creels the threads pass radially to the braiding point, the thread from the lower creels being taken through grooves in the upper stationary disc. The braiding action is brought about by regulating the number of creels and the speed of the revolving disc. —B.C.I.R.A.

Figured Satin: Weaving. B. Font. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 467-468.

Point paper diagrams are given for weaving in satin geometrical patterns based on the squares formed when the tie points of the satin weave are joined by straight lines. —B.C.I.R.A.

Volech Loom. J. Funke. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 472-473.

A new loom for producing fabrics of complicated weaves, striped, ribbed, multicoloured, &c., is designed to limit as far as possible the number of cards. The patterning mechanism is of the Hattersley dobby type. —B.C.I.R.A.

Pleated Fabrics: Weaving. J. Funke. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 4-5.

The methods of weaving transverse and longitudinally pleated fabrics by suitably arranging the warp is described. The warp may be made up of yarns of different elasticities or of yarns with different tensions, or the warp density may be greater in the ground than in the pleats. Fabrics with vertical pleats are produced by the more complicated arrangement of warp threads described. —B.C.I.R.A.

Loom Pickers: Manufacture; and Shuttles: Adjustment. G. Steiner. *Melliand's Textilberichte*, 1925, **6**, 572-575.

A general article on the manufacture and treatment of pickers and the care of shuttles for power looms. A machine for adjusting shuttles and sharpening the tips is illustrated; the knife of this machine can be sharpened without removing it from the machine. The oil used for lubricating picker spindles should be 100% saponifiable, acid-free, not readily volatile, and not inclined to form incrustations. Neatsfoot oil gives the best results but is too expensive. Oils in general are, however, reliable. —B.C.I.R.A.

Grossenhainer Loom. Grossenhainer Webstuhl und Maschinen Fabrik, A.G. *Melliand's Textilberichte*, 1925, **6**, 577-578.

The chief features of the latest loom built by the Grossenhainer Webstuhl und Maschinen Fabrik A.G. are its low construction, ready visibility of all mechanical parts and reliable change motion and jacquard mechanism. By having a long lay motion a big shed is obtained without putting any strain on the warp. The shuttle requires less powerful picking so that the weft is conserved and yarn breakage seldom occurs. The loom has also a fully automatic double control of the beat-up and a new automatic shuttle catching device. —B.C.I.R.A.

Jacquard Fabric Weaving Diagrams: Preparation. F. Müller. *Melliand's Textilberichte*, 1926, **7**, 5-9.

The preparation of point paper diagrams for jacquard designs and the various available types of squared paper and their application are discussed. —B.C.I.R.A.

Pile Fabrics. E. Frotscher. *Melliand's Textilberichte*, 1926, **7**, 9-10.

Weaving details are given for two new pile fabrics one of which has the pattern raised on a plain woven background on one side and on the other has the appearance of a repp, whilst the other is a fancy plush with a 5 mm. pile. —B.C.I.R.A.

Verdol Jacquard Machine. E. Ullrich. *Melliand's Textilberichte*, 1926, **7**, 10-11.

A detailed account of an improved two-cylinder Verdol jacquard. —B.C.I.R.A.

Electric Drive of Looms; Individual——. *Text. Rec.*, 1926, **43**, No. 515, p. 92-93.

A description of the Jones patent individual loom motor made by Tate & Co., Bradford. A single plate centrifugal clutch and chain drive are employed. In starting, the loom is accelerated to full speed during the first pick and in "banging-off" the immediate disengagement of the clutch obviates the imposition of severe stresses on the loom mechanism. —L.I.R.A.

Artificial Silk Brocade: Weaving. *Kunstseide*, 1926, **8**, 7-13.

The production of brocade fabrics made with a cotton warp and a weft of artificial silk or artificial silk and metallic yarns is described. The material is woven in the ordinary way on a jacquard, but if artificial silk is employed also for the warp special precautions are necessary in respect of tension, size of any knots, &c., and care must be taken that the loom is smooth-running. —B.C.I.R.A.

Artificial Silk Brocades: Weaving. *Kunstseide*, 1926, **8**, 32-38.

The method of weaving furnishing and decorative fabrics employing artificial silk in the weft is described. Artificial silk of high denier necessitates the use of a cotton shuttle and the problem of efficient braking has not been solved. Rabbit skin lining and other means are suggested. The pirn requirements are also discussed. A sample is furnished of a fabric in which the warp is of mercerised cotton and the weft of a mixture of cotton, artificial silk, and a gilt thread called "Bayko-metal yarn" of which samples are given. Shuttles for carrying metallic threads are illustrated. —B.C.I.R.A.

Artificial Silk Elastic: Manufacture. O. Both. *Kunstseide*, 1926, **8**, 40-43.

An account of the manufacture of elastic articles such as garters, braces, belts, &c., which are woven on ribbon looms or braiding machines and in which the warp is formed of rubber filaments under tension and the weft of artificial silk mixed with cotton. Patterns of elastics with artificial silk decorative effects are furnished. —B.C.I.R.A.

(D)—Knitting

Circular Knitted Fabric Separating Thread: Reinforcing. L. de Séréville. *L'Avenir Text.*, 1925, **7**, 611-614.

A device is described for preventing the trouble caused by breakage on unravelling the thread used to separate the edges of a bordered fabric knitted on a circular loom. The invention consists in adding to the connecting thread a firm reinforcing thread to be worked on the needles only during the actual knitting of the separating thread and to be pulled out at the same time as the latter. By this means it is possible to replace the good quality separating threads hitherto used by cheaper ones. —B.C.I.R.A.

Artificial Silk: Application. K. Aberle. *Melliand's Textilberichte*, 1926, **7**, 33-36.

The extensive application of artificial silk in the knitting industry is discussed, especially in relation to the various types of knitting machine available. —B.C.I.R.A.

(E)—Lacemaking and Embroidering

Dissoluble Background Embroidery Lace (Aetzspitze): Manufacture. F. Müller. *Melliand's Textilberichte*, 1926, **7**, 134-137.

The lace described is made by embroidering designs in textile or metallic yarns on a specially woven and generally dyed background of cotton, wool, and/or silk fabric, and subsequently removing the whole of the background by burning or by chemical treatment. The process is cheap and simple and enables the so-called real laces to be successfully imitated. Silk backgrounds are generally used for the production of cotton and metallic laces. Cotton lace is dyed after the removal of the background. Cotton muslin backgrounds are used for silk artificial laces and

are removed by a dry process in which the muslin is submitted to a special preparatory process and after the completion of the embroidery is burnt away. A typical muslin for the purpose has 30 ends and 30 picks per cm., is woven in plain weave from 2/60's warp and 60's weft yarn, and has a breadth of 1·2, 1·6, or 2 metres.
—B.C.I.R.A.

(G)—Fabrics

Artificial Silk Lining Fabrics. Herminghaus and Co., G.m.b.H. *Melliand's Textilberichte*, 1926, **7**, 26-27.

Two samples of artificial silk lining fabrics produced by the Herminghaus & Co. G.m.b.H. are provided. The firm produces its own artificial silk which is manufactured by viscose process. —B.C.I.R.A.

Patents

Sizing Compound: Preparation. G. Bozzetto. Swiss P.105,466 (from *Chem. Zentr.*, 1926, i., 1721).

Paraffin is mixed with tallow and colophony, dried, powdered, and mixed with gum arabic, soap, potato starch, sodium perborate, and sodium carbonate.
—B.C.I.R.A.

Chenille Loom Change-box Mechanism. A. Betchtold, Wurzen, Saxony. E.P. 246,536.

In a chenille loom, change of shuttle is determined by a jacquard mechanism which controls both the shuttle-changing mechanism and a repeat mechanism in such a way that the card of the jacquard mechanism is only fed forward through one division by the repeat mechanism when, according to the repeat mechanism, another colour is to be thrown.
—B.C.I.R.A.

Loom Jacquard Mechanism. T. Ryffel-Frei, Meilen, Zurich, Switzerland. E.P. 246,705.

A link for the neck cords and hooks of double lift jacquard looms is formed at each end of the step with projecting portions in which the hooks engage. The legs of the link are bent back on themselves and are both engaged by a slip knot on the neck cord which closes the link. —B.C.I.R.A.

Looms: Friction Brake Device for Warp Beam. A. Smith and G. W. Shackleton, Keighley, Yorkshire. E.P.246,931.

The device described consists of a movable weight which can be shifted along a balanced lever by an equal-armed bell crank, so that the distance of the point of suspension of the weight from the spindle of the lever always equals the radius of the warp on the beam. A spring holds the arm of the bell crank in contact with the warp. By a system comprising an arm and a lever, adjustable brake chains are controlled so as to be under equal pulls, but can be disconnected if required.
—H.L.R.

Loom Picking Motion. J. E. Grosvenor, Hagley, and W. T. Picking, Kidderminster, both Worcestershire. E.P. 246,961.

A spring picking-motion operated by one spring is so designed that two or more shuttles may be picked in succession at will from either side of the loom as determined by pattern mechanism. Two levers connected by an adjustable connecting rod, a compression or tension spring, and a flexible strap, are linked to move together outwardly or inwardly. A quadrant pivoted on the shaft of one of the levers is oscillated continuously by a cam-operated lever. When the quadrant turns in a clockwise direction a projection moves the upper part of the lever to the right and a projection is moved into position to be held by a latch. When the quadrant moves in the opposite direction, an adjustable screw engages the tail of the latch to release the lever, both levers thereby moving inwardly under the influence of a spring. The levers are adapted to turn levers connected to the picking sticks.
—B.C.I.R.A.

Loom Picking Motion. Bergmann-Elektricitäts-Werke A.-G., Seestrasse, Berlin. E.P.247,204.

In looms in which the picking is effected by cranks or eccentrics, &c., and the speed of the loom can be varied without altering the speed of the picking device, as set out in Specification 242,255, the position of the loom at which the operation of the picking device is initiated is varied in accordance with the speed of the loom at any time. An eccentric controlling the picking is mounted loosely on the picking shaft and normally hangs down in an inoperative position, but at the required times is actuated by a stud on an arm on a hollow shaft driven at half the speed of the crankshaft. The eccentric is thus rotated and a roller thereon engages a guiding member which forces the eccentric into contact with a disc fast on the picking shaft. The stud may be adjusted in a slot in the arm by mechanism controlled by a rod which may be displaced manually. The time and position of the loom at which the pin actuates the eccentric can thus be varied, the pin being brought nearer to the axis of rotation when the speed of the loom increases and the interval between the coupling of the picking eccentric with the picking shaft being correspondingly increased. The displacement of the rod may be governed by the apparatus which adjusts the speed of the loom. —B.C.I.R.A.

Looms: Hand-threaded Shuttle. C. H Wilkinson, Etherstone, Leigh, Lancs. E.P.247,251.

The shuttle-threading means comprise a keyhole slot in the side of the shuttle communicating with a vertical recess through which and the larger part of the slot, the thread can be passed by the fingers.

A vertical stud crosses the slot and is bifurcated transversely of the shuttle axis. One leg of the stud is shortened and bevelled and the shuttle is cut away round it to allow the thread to be pulled into the bifurcation from the slot. A recess communicates with the cop recess by a slot in which is fixed a forked stud. The stud may be formed with a groove designed to catch ballooning thread. If the studs are of metal, they are fixed by forked extensions thereon, with or without glue; if of china, they are made a tight fit and glued in position. —B.C.I.R.A.

Circular Knitting Machine Plating Mechanism. P. A. Bentley and Bentley Engineering Co., Clarendon Park, Leicester. E.P.247,334.

Knitting machines of the superposed cylinder type are provided with means for reversing the position of yarns at the knitting point, so that one yarn may be employed alternatively as a plating to the other. The reversal is described as carried out at intervals and means are provided for cutting out the reversing device when a plain fabric is to be knitted. In the construction shown, a pair of yarn feeders is mounted in slides in a bracket adjacent to the cylinders. The feeders have eyes through which the yarn passes to a slot in a plate, this slot having a horizontal portion with an offset. The two yarns at a given moment are located one in the notch and the other at one end of the slot, the end depending on the direction of rotation of the cylinder. On movement of the yarn feeders to advance the retracted one and retract the advanced one, the lead of the yarn to the needles is altered so that the positions of the yarns in the notch and slot are interchanged. —B.C.I.R.A.

Circular Knitting Machine Plating Mechanism. W. Spiers, Walnut Street, Leicester. E.P.247,336.

The patent relates to the production of reverse plating from two or more yarns, striped or split effects being thus obtained on a plain machine and checked effects on a rib machine. The device is capable of operating during reciprocation to produce hosiery with striped or tipped heels and toes. The invention is described as applied to the superposed-cylinder type of machine. —B.C.I.R.A.

Circular Knitting Machine. A. V. Clarke and C. G. Gilbert, Leicester. E.P. 247,339.

Circular machines of the superposed-cylinder type are provided with bearded needles throughout. The double-ended needles and operating sliders described in Specification 230,584 may be used. The sliders may differ in length. —B.C.I.R.A.

Fabrics: Sizing. C. B. Johnson, New Jersey, U.S.A. E.P.247,427.

Superposed coacting squeeze rolls for sizing fabric are rotated by a variable speed drive which allows of exact adjustment of the peripheral speed of the squeeze rolls to that of the drying rolls which draw the fabric forward. The fabric is drawn from a beam on a carriage movable transversely on the machine, passed between either pair of sizing rolls then round three drying drums and is finally wound on a beam. The method of gearing is described. —B.C.I.R.A.

Shuttle Tensioning Device. C. H. Wilkinson, Leigh, Lancs. E.P.247,487.

The tensioning device consists of a stud having a waved slot therein for imparting drag to the thread. The stud may be made of metal by brazing or welding together suitably shaped halves or of porcelain, when it is moulded or cast. —B.C.I.R.A.

Pile Fabric Loom Beat-up Motion. T. B. Worth & Sons, Stourport, and A. Davis, Kidderminster. E.P.247,631.

In weaving pile fabrics in which the tufts are formed round some of the weft threads the weft threads carrying the tufts and the binding weft threads are beaten up by separate lays. In the supplementary lay the reeds are soldered or otherwise fixed in slotted plates bolted to the lay. The lay is raised and lowered by a lever and cam mechanism, and an extension of the lay is actuated by a cam to give it the requisite beat-up motion. The supplementary lay may have the same number of dents as the main lay. —B.C.I.R.A.

Openwork and Patterned Fabrics: Weaving. R. Farnworth, Orient Mill, Bolton. E.P.247,723.

A fabric is made by arranging the ground warp threads in bunches and weaving them at all times with the ordinary weft threads, which are also interwoven with the lappet threads to produce the pattern desired. In order to extend the patterns, the tappet for operating the needle bars carries a ratchet wheel and a concentric loosely mounted larger ratchet wheel operated by a pawl. Normally the larger ratchet wheel only is operated but when the pawl engages a deeper tooth, formed by coincidence of two angles one on each wheel, the tappet is operated. The provisional specification describes also the employment of three ratchet wheels. —B.C.I.R.A.

Picker-stick Carrier. G. Tomkinson and H. Young, Kidderminster. E.P.247,731.

A carrier for a picking stick comprises an upper vertical part carrying a shoe for the stick pivoted to a lower horizontal part rocking on a pin. The strap loop is also attached to this upper part and the stick is bolted to the shoe. At the side opposite the pivot the upper part is joined to the lower part through a spring. A leaf spring on the lower part bears against the back of the strap loop. When the stick strikes the buffer it can rebound by stressing the two springs. —B.C.I.R.A.

Fabric Feed Mechanism. J. E. Wenzel, Wettiner Strasse, Aue, Germany. E.P. 247,760.

In a device for drawing off fabric webs from drying machines wherein the web is carried in loops depending from rods supported on rails and carried by endless chains, the web is drawn off intermittently by constantly driven friction rollers against the tension of a heavy roller lowered into the loop of the web by a cord. While the heavy roller is being lowered into the loop of fabric the web is held by a brake carried by a weighted lever co-operating with a smoothing rail. —B.C.I.R.A.

Knitting Machine Thread Guide. M. Epelbaum, Boulevard Voltaire, Paris. E.P.247,959.

The thread guides or levers on a knitting machine are controlled and operated by means of tappets on the jacquard cards which act directly on pawls connected to the levers by wires. These wires are attached to pistons sliding in cylindrical conduits in a block. The pawls are pivoted to lugs on the piston sliding in slots. The wires are enclosed in casings. When a lever is lowered by the action of the jacquard, the movement raises, in the known manner, the lever which was previously lowered. —B.C.I.R.A.

Looms: Automatic Weft Changing Mechanism. M. A. Cohen, Lachen, Switzerland. E.P.248,010.

The bobbin transfer is controlled by weft-feeler devices acting when the bobbin is substantially exhausted, and also by the weft fork mechanism acting on breakage of weft. It is stated, however, that in an alternative arrangement the weft form mechanism may be caused to stop the loom. A warp protector or shuttle feeler is used to prevent bobbin transfer in case the shuttle is not correctly positioned, and a scissors device on the shuttle feeler cuts and clamps the weft end from the old bobbin when bobbin transfer occurs.

—B.C.I.R.A.

Circular Knitting Machine Patterning Mechanism. Mellor, Bromley & Co., Leicester. E.P.248,054.

In circular rib machines provided with patterning wheels, &c., for selecting certain needles to be fed with yarn of various colours so as to produce a pattern, a device such as a cam is employed to deflect the selected frame or cylinder needles from their normal track so that they follow a non-clearing or tucking track. In conjunction with this arrangement there is employed, at an adjacent yarn feeding station, an auxiliary cam for raising all the needles to clearing height so that they take the yarn at that station and by co-operation with the first deflecting arrangement produce the knitting of a strip of non-patterned material.

—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Preparatory Processes—

247,064. Barber-Colman Co. Creel brake device for warping machine.

Weaving—

248,119. A. W. & J. R. Green and F. P. French. Healds for coir-mat looms.

248,151. G. R. Smith. Harpoon device for pile-fabric looms.

Knitting—

247,758. H. May. Device for lifting cams in parallel machines.

Fabrics—

247,234. Aluminium-Walzwerke Singen Dr. Lauber, Neher Co., Ges. Process for making imitation silk or brocade tapestry.

247,282. G. E. Farragut. Fabric ornament device.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming

Textile Softening Oils: Preparation. H. Pomeranz. *Leipiziger Monats. Text.-Ind.*, 1925, **40**, 262-263.

Remarks on the preparation of satisfactory textile oils (liquid soap and mineral oil), particularly from the point of view of their emulsion-forming capacity with water in the scouring process. The use of readily oxidised fatty oils is recommended.

—B.C.I.R.A.

Degumming [Natural] Silk. *Textile Argus*, 19/5/26, p. 7.

Practical details are given of the degumming of skeins of natural silk yarn, reference being made to pre-steeping, degumming with boiling soap solutions and the final process of washing off. —A.J.H.

(F)—Carbonising

The Treatment of Burry Worsted. *Melliand's Textilberichte*, 1926, **7**, 369 (from *Z. ges. Text. Ind.*, 1925, **28**, 415).

The deburring of wool may be brought about chemically (carbonisation) or mechanically. The latter method does not attack the fibres so much and is therefore preferable. Some hints for a suitable preliminary for treating burry wool mechanically are given and the action of the apparatus is described. B.R.A.W. & W.I.

(G)—Bleaching

Bleaching. R. Roestel. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 61-62.

More rapid and uniform bleaching is obtained by the use of electrolytic bleaching solutions than by bleaching powder, and there is less danger to the fabric under

treatment. A suitable electrolyser for textile purposes is of sandstone, provided with glass partitions forming a series of cells. The electrodes are of platinum-iridium wire gauze, or the kathode may be of graphite. A small type of electrolyser for works in which the consumption of bleaching liquor is low is also available.
—B.C.I.R.A.

Peroxide Bleach: Tendering in Presence of Copper. W. Heinisch. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 175.
Wool yarn bleached with hydrogen peroxide was found to be tendered at those points at which it was in contact with light brown strands of cotton used to tie up individual skeins. The ash of the cotton strand contained oxides of copper and chromium, indicating a catechu dyeing applied with copper sulphate, and the cause of the tendering was traced to the catalytic action of copper salts on the hydrogen peroxide. —B.C.I.R.A.

"Oranit" Cold Bleach: Application. Chemische Fabrik Milch Aktien-Gesellschaft. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 367.
The boiling process in bleaching may be dispensed with in certain instances by using the Oranit cold bleaching process which is claimed to be cheaper and quicker than the ordinary hot process and may be used for preliminary colour removal or for the complete bleaching of various articles. Full particulars are obtainable from the makers. —B.C.I.R.A.

"Perlano T": Application. H. Th. Böhme. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 367.
In the bleaching process the time of boiling may be shortened by adding to the ordinary boiling liquid (2-4% caustic soda solution) about 300-500 grams of Perlano T to 100 kilos. of material. A whiter product is obtained with the use of weaker chlorine and acid baths. —B.C.I.R.A.

Wood Cellulose: Bleaching. H. Wenzl. *Papier-Fabr.* (Verein Zellstoff Ing.), 1926, **24**, 81-88.
The resulting effect on the composition of the wood cellulose on bleaching with the hypochlorites of calcium, magnesium, sodium, and barium is described and the following constants are given—ash content, water, α-cellulose, baryta-resistant cellulose, corrected barium and copper numbers, hydrate-copper number, pentosans, furfurol. The effect of adding neutral salts is discussed and the results shown in terms of whiteness measured by the Ostwald half-shadow photometer. The course of the bleaching process is demonstrated by curves connecting time and the amount of unused chlorine present at a given time. The following conclusions are reached—(1) Strongly hydrolysed hypochlorite solution bleaches actively. (2) The solvent power of alkali hypochlorites for cellulose incrusting substances is greater than that of alkaline earth hypochlorites. (3) Neutral salts influence the solubility in the bleach liquor of the oxidation products of the incrustations. (4) Neutral salts influence also the solubility of carbon dioxide, thereby affecting the bleaching process. (5) Whiteness measurements indicate that bleaching powders having greater chloride-chlorine content give worse results for the same consumption of available chlorine. (6) Larger additions of neutral salts diminish in general the bleaching effect for the same consumption of available chlorine. (7) Bleaching in steps by inserting an intermediate washing with water, soda solution or dilute acid does not add to the whiteness effect. (8) Fibres loaded with calcium carbonate give defective bleach effects. (9) The amount of residual chlorine allows of the course of the bleaching process to be followed. (10) The carbonate content of sodium hypochlorite solutions is of predominating importance for the rate of bleaching and the bleach results. The activity of the CO_3-ion is confirmed anew. (11) Chlorides and sulphates retard the bleaching process, but if by them carbonate is precipitated, a measurable acceleration of the process is apparent. (12) The addition of nitrate and chlorate retards the process. (13) The presence of acetate causes a rapid absorption of chlorine with an adverse effect on the bleach. The presence and activity of salts of lower fatty acids in exhausted bleaching liquors and their activity in the described sense is to be assumed. —B.C.I R.A.

Bleaching of Cotton. J. S. Heuthwaite. *Dyer and Calico Printer*, 1926, **55**, 230-231.
A discussion of the theory and practice of kiering. —A.J.H.

Corrosion from Cotton Dyeing and Finishing. W. W. Chase. *Text. Mfr.*, 1926, **52**, 134-135.
The author makes suggestions as to suitable materials for the construction of tanks, rollers, &c., which come into contact with corrosive solutions in bleaching, dyeing, and finishing operations. —L.I.R.A.

Bleaching Powder: Constitution. B. Neumann and F. Hauck. *Z. Elektrochem.*, 1926, **32**, 18-31.
The authors arrive at the formula—

$$3\,[CaCl(OCl)]\cdot CaO\cdot 6H_2O$$

They emphasise the importance of using high quality raw material to obtain a stable product. Weak, damp or greasy bleaching powder is caused by the presence of carbon dioxide as impurity in the lime or chlorine used in the manufacture.
—B.C.I.R.A.

Aktivin: Application. R. Feibelmann. *Melliand's Textilberichte*, 1926, **7**, 47-48.
Aktivin is a useful bleaching agent for viscose. It has no adverse effect on the

lustre or strength when applied in 3-4% concentration at temperatures of 60-70°. The shade obtained is not white but a uniform pale cream. The consumption of Aktivin is low since only the required amount of chlorine is furnished, and at the completion of the process the amount of Aktivin used can be determined by titration with thiosulphate and potassium iodide and the solution brought up to its original concentration. An enhanced bleaching effect is obtained in acid solution at ordinary temperatures and the viscose is bleached to white. To a bath containing 3 grams of Aktivin per litre, 5 c.cs. of 50% formic or acetic acid is added. The silk suffers no damage, even if the temperature is raised. After bleaching, which requires about 30 mins., the bleached material is treated with a bisulphite or antichlor solution. Viscose bleached with Aktivin behaves more uniformly on dyeing than ordinarily bleached viscose. The bleaching of other types of artificial silk by Aktivin has not yet been studied.

—B.C.I.R.A.

(H)—Mercerising

Cotton Glove Fabric: Mercerisation. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 225.

A particular application of the mercerising process confers on cotton glove fabric an appearance and feel resembling that of wool. The fabric from the loom is boiled and then treated with sodium hydroxide solution of 20-26° Bé. without tension and, after wringing, is spread out until the next day. It is then washed and bleached or acidified and dyed. Lustre and absorptive power are materially increased by the process and the resulting fabric is of closer and thicker texture. It is finished on a felt-covered calender and roughened on an emery surface. There is a small loss in length and width of the fabric.

—B.C.I.R.A.

Weaving Shed: Humidification. P. Beckers. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 237.

Brief notes on modern methods of humidifying the air of weaving sheds and on the instruments by means of which relative humidity is measured and controlled.

—B.C.I.R.A.

Mercerising; One-side Cloth——. R. Sansone. *Text. Rec.*, 1926, **43**, No. 516, p. 59 and p. 61.

The author describes plant suitable for mercerising cloth on one side only. Such treatment may be used with advantage in a number of cases, as for example when it is desired to shrink cloth on one face only. Similarly the affinity of one side of the cloth for dyes may be made different from that of the other side. One-side mercerising, if properly conducted, may also be used for treating artificial silk union fabrics with a cotton back.

—L.I.R.A.

Mercerisation; A Simple and Reliable Test for——. R. W. Kinkead. *J. Text. Inst.*, 1926, **17**, T213-T219.

Cellulose Mercerising Press. E. Brem. *Melliand's Textilberichte*, 1926, **7**, 46-47.

The machine is a combined mercerising trough and horizontal press for the mercerisation of cellulose for the manufacture of artificial silk. The sheets of cellulose are placed in a cage alternately with sheets of lead, and when hydraulic pressure is applied the lead sheets move closer together with the cellulose sheets. When sufficient pressure has been applied the cage is raised by pulley mechanism, the sieve floor is opened and the cellulose falls out. The cage is returned to the press and the lead plates return to their original positions. The whole process of raising, emptying, and lowering the cage takes less than five minutes and one worker can mind two presses. A feature of the apparatus is the provision of weighing mechanism with the cage lifting mechanism, so that the cellulose sheets can be weighed and the alkali content determined. —B.C.I.R.A.

Hank Mercerising Machine. A. Chaplet. *Melliand's Textilberichte*, 1925, **6**, 863 (from *Rev. Gen. Teint. Blanch.*, 1924, **2**, 993, 1925, **3**, 39 and 131).

A comprehensive review of various machines designed for hank mercerising. Twenty-eight illustrations are included.

—L.I.R.A.

(I)—Dyeing

Cellulose Esters: Dyeing Properties. A. Caille. *Chem. et Ind.*, 1926, **15**, 61-64T.

The fixation of basic dyes on cellulose derivatives is not entirely due to the existence of oxycellulose; the content of combined sulphuric acid groups in the nitro- and acetyl-celluloses largely determines the fixation. Generally, the tabulated results establish a direct relation between the content of combined sulphuric acid present in cellulose acetates and the fixation of basic dyes. The quantities of basic dyes fixed by 100 grams of acetate are of the same order. Results obtained with lime water and distilled water prove that the fixation is not chemical in nature. The combined acetic acid appears to play only a secondary part in the fixation of basic dyes. —B.C.I.R.A.

Gelatin Gel: Penetration by Dyes and Effect of *p*H. H. Mommsen. *Biochem. Z.*, 1926, **168**, 77-87.

In a study of the influence of hydrogen-ion concentration on the diffusion of dyestuffs into gelatine gels the author confirms Bethe's hypothesis that changes in membrane permeability result from causes other than change in the rate of diffusion. The rates of diffusion of dyestuffs which penetrate (*a*) acid gelatines, (*b*) alkaline gelatines are so affected that acid dyes are

retarded in the acid gels and basic dyes in the alkaline gels, and the results are the same if the dyestuff diffuses from gelatinous or aqueous solution. The quantities which have penetrated are in those experiments covering diffusion from a gelatinous solution nearly proportional to the diffusion distance. In diffusion from an aqueous solution the quantities penetrated in terms of the diffusion distance are for acid dyes greater in the acid, for basic dyes greater in the alkaline gels. An explanation of this behaviour is looked for in the changed adsorption ratios. —B.C.I.R.A.

Fastness to Ironing of Dyestuffs. R. Haller. *Kolloidzeitschrift*, 1926, **38**, 248-253.
An examination of the lack of fastness to ironing of certain substantive cotton dyes has led to an explanation based on a previous hypothesis of Justin Muller. The dyestuff is considered to be present in an equilibrium mixture of two forms in different states of dispersion: heating deepens the colour by partly converting one of these into the dehydrated, more highly dispersed form—a reversible process. —L.I.R.A.

Alizarin Red Mordant: Preparation. W. Alterhoff. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 216.
The author describes an improved method for dyeing silk with Alizarin Red, using an alum mordant, by which the harsh feel is eliminated and a dyeing is obtained which is fast to bleaching, boiling, and rubbing. Directions are given for preparing the mordanting solution and the dyebath to secure complete freedom from iron.
—B.C.I.R.A.

Turkey Red and Naphthol A.S. Red: Application. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 225-226.
An outline of the methods of applying Turkey Red and its substitute Naphthol Red A.S. to cotton fabrics is given; the fastness of the dyes to boiling under pressure and to bleaching, &c., is discussed.
—B.C.I.R.A.

Logwood Black: Analysis. K. Brass. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 263-265.
A report of comparative analytical tests of logwood blacks of German and French origin (Noir réduit) to discover wherein lay the alleged inferiority of the German product. Results are given for residue on heating, ash analysis, volatile acids, and total acidity, and the iron corroding properties of both were investigated. No grounds for the supposed inferiority of the German article could be discovered.
—B.C.I.R.A.

Dyes: Fastness in Tropics. C. G. Cheribon. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 265.
The author cites examples of dyestuffs and chemicals which are unstable under the climatic conditions of the Tropics. Hydron Deep Blue E gave a brilliant violet shade, and faulty Batik dyeings were obtained with Naphthol Red and Fast Red salt 3GL. Hydrosulphite and sodium sulphide underwent the changes normally occurring when these compounds are heated. —B.C.I.R.A.

Artificial Silk: Streaky Dyeing Effects. L. Bochmann. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 360-361.
The cause of streaky dyeing effects is attributed to variation in the acid content of the spinning bath, because the more acid is the bath, the more complete is the precipitation of the cellulose xanthate compound and the lower its absorptive power for dyes. By the ordinary method of spinning there must necessarily be a definite variation in the acid strength of the bath at the beginning and end of the spinning process. Further possible contributory causes are traces of sulphur remaining on the filaments and not removed in the subsequent desulphurising of the yarn, or in the cuprammonium process traces of residual copper salts.
—B.C.I.R.A.

"Dekol": Application. Badische Anilin and Soda-Fabrik. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 363.
Dekol added to dyebaths in which lime is present in the water prevents damage to the goods caused by the precipitation of calcium salts, notably speckled appearance, harsh feel, &c. It also aids even dyeing with indanthrene, vat and sulphur colours.
—B.C.I.R.A.

Perborate: Applications. M. Remy. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 408.
The use of perborate instead of potassium chromate for the after oxidation of Aniline Black printed on a white ground is described. It may also be used for the after-oxidation of vat dyes and as a substitute for thiosulphate in the after-treatment of bleached goods.
—B.C.I.R.A.

Ostwald Colour Theory: Application. E. Ristenpart. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 447-450.
A lecture on the Ostwald colour theory and its application in the textile industry. Very briefly, from a measurement of the content of "black" and "white" in a colour, Ostwald ascribes any colour to the place it occupied in his triangles of uniform colour. He discusses the measurement, identification, classification, standardisation and harmonious combination and mixing of colours. The Pulfrich sensitive photometer is described in detail with diagrams. —B.C.I.R.A.

Condensation; Physical, of Dyes on Fibre. R. Haller and A. Ruperti. *Cellulosechemie*, 1925, **6**, 189-195.
Cotton fibre dyed with various vat dyes, substantive dyes, and dyes fixed by mordants, when steamed under pressure

changed in colour tone and eventually dye crystals were produced on the outer and inner surfaces of the fibre, the former being easily removed by washing or rubbing. Factors influencing this physical migration and condensation of dyes are the concentration of the dye, the pressure used in steaming and the time of steaming. In most cases simple heating in a boiling dye-bath was insufficient, but often protracted heating under slightly increased pressure caused condensation of the dye. Dry heat was without action. Indigo, Thioindigo, Indanthrene Red 5GK, Diamine Blue 3R, Congo Red, Congo Corinth, and Alizarin Red showed condensation when steamed under pressure. Other dyes, while not giving actual condensation of the dye particles at the fibre surface, showed a change in colour tone. —L.I.R.A.

Dyeing and Calico Printing. G. Walter. *Melliand's Textilberichte,* 1925, **6**, 592-596.

A short review of the work of Pauli in the field of colloid chemistry, indicating some applications of his conceptions to the theory of dyeing and calico printing. —B.C.I.R.A.

Katanol W: Application. G. Rudolph. *Melliand's Textilberichte,* 1926, **7**, 88 (from *Dtsch. Färber-Ztg.*, 1925, **61**, 107).

Katanol is used chiefly in half-wool and half-silk dyeing and is a protective agent in that it prevents substantive dyes from going on to the wool and silk whilst having no influence on the dyeing of the cotton. In redyeing the cotton in half-wool products with substantive dyes in a neutral Glauber salt bath the process may be carried out at 75-80°, without change of shade of the wool, if 3% of Katanol is added. Katanol can also be added when the wool is sufficiently dark in colour, whilst the dyeing of the cotton is incomplete. If Katanol is added at the beginning of the dyeing it considerably diminishes the absorption of wool of both neutral-dyeing acid dyes and substantive dyes. The wool should be dyed in a preliminary bath and the cotton subsequently dyed with substantive dyes from a bath containing Glauber salt and 3% of Katanol, when the dyeing may be carried out at 75-80° without change of shade of the wool. In half-silk dyeing, the replacement of the usual alkaline soap bath by a Glauber salt bath containing 3% of Katanol gives a darker colour on the cotton and a purer silk. Alternatively, the Glauber salt and Katanol may be added to the soap bath. The silk remains purest if the fabric, before dyeing, is treated for 1 hour at 80-90° with 8-10% of Katanol and 3-4% of formic acid. Two-colour effects are best obtained by pre-dyeing the silk with acid dyes and subsequently dyeing the cotton with substantive dyes with the addition of 3-4% of Katanol. —B.C.I.R.A.

Light-fastness of Naphthol AS combinations; Investigations on the Influence of After-treatment on the——. E. Kayser. *Melliand's Textilberichte,* 1926, **7**, 437-440.

Following up the work of Lochner (*Melliand's Textilberichte,* 1926, No. 3), who showed that soaping at the boil considerably increased the light-fastness of Naphthol AS dyeings and of Haller (1925) who investigated the migration of dyestuff particles in the fibre under the action of heat and pressure, the author has made experiments which show the inter-relationship of these two phenomena. He considers it probable that the increased light-fastness of soap-boiled Naphthol AS dyeings is due to migration of the dye-particles to the lumen of the fibres, where they are more protected from the action of the light, and to an increase in the size of the dyestuff aggregates. —L.I.R.A.

Immunised Yarn. M. Fahrlander. *Melliand's Textilberichte,* 1926, **7**, 463-464.

Cotton yarns, whether grey, boiled, bleached, mercerised or dyed can be "immunised" to resist direct, sulphur, vat, and acid dyestuffs. The uses of immunised yarn are described in a brochure issued by the Chemische Fabrik vorm. Sandoz, Basel. Samples of effects which may be obtained by the use of the immunised yarn are given in this brochure. —L.I.R.A.

Dyeing of Artificial Silk. E. Greenhalgh. *Dyer and Calico Printer,* 1926, **55**, 190-191.

A further description of methods for dyeing artificial silk materials, reference being made to scouring, "blinding," and after-treatments suitable for facilitating subsequent winding of dyed yarn. —A.J.H.

Dyeing Cotton Artificial Silk Piece Goods. H. Blackshaw. *Dyer and Calico Printer,* 1926, **55**, 192-193.

Methods for dyeing cotton-cellulose acetate silk union materials are described. —A.J.H.

Selection of Dyestuffs for Various Purposes (Dyeing). L. P. Rendell. *Dyer and Calico Printer,* 1926, **55**, 194-196.

Reference is made to various dyestuffs and their combinations which are suitable for dyeing particular types of cotton and wool fabrics and yarns such as dress materials, shirtings, serges, pile fabrics, and knitting yarns. —A.J.H.

The Behaviour of Glucose and Certain other Carbohydrates towards Dyestuffs and towards Potassium Ferricyanide in an Alkaline Medium. E. Knecht and E. Hibbert. *J. Chem. Soc.,* 1925, **127**, 2854-2860.

It is shown that, in an alkaline medium, glucose, lævulose, and certain other carbohydrates are oxidised to a definite degree of Methylene Blue and by potassium indigotintetrasulphonate. Glucose, glucosamine,

and galactose take up, under the conditions, exactly three, and lævulose four, atomic proportions of oxygen. Potassium ferricyanide can replace the dyestuffs in these estimations. When boiled for two minutes with excess of caustic soda in an atmosphere of nitrogen, both glucose and lævulose neutralise an amount of alkali corresponding exactly to the formation of two molecules of lactic acid. When glucose is boiled with excess of potassium ferricyanide and caustic potash, the amount of alkali neutralised (over and above that required to form potassium ferrocyanide) represents exactly three equivalents of caustic potash. In the case of lævulose, the amount of caustic potash neutralised is approximately four equivalents. Glycuronic acid can be estimated quantitatively by titration with potassium indigotintetrasulphonate. The volumetric osazome titration method may also be employed for the purpose. In presence of caustic alkali, glucose is also oxidised quantitatively by Kitone Blue and by rosinduline. In the former case two atomic proportions of oxygen are supplied by the dyestuff and in the latter case one proportion. —L.I.R.A.

Fast Cotton Reds: Dyeing. R. Sansone. *Text. Mfr.*, 1926, **52**, 166-167.

An article dealing with the choice and application of red substantive dyes fast to light only. A list of suitable shading colours is given and a method of testing fastness to light is described. —L.I.R.A.

Non-denitrated Nitro Silk: Dyeing. K. H. Meyer, C. Schuster, and W. Bülow. *Melliand's Textilberichte*, 1926, **7**, 29-30.

The experiments previously described have been extended to non-denitrated nitro silk, which is found to behave as the acetate silk behaved. It dyes with the same types of dyes, especially the weakly basic, sulphofree compounds, and takes up the dye from aqueous solution in accordance with Henry's Law. —B.C.I.R.A.

Dyes: Fading. P. Lasarew. *Chem. Zentr.*, 1925, **i.**, 2657 (from *Bull. Acad. St. Petersbourg*, 1916 (6), 583-588).

A study of the effect of compressed oxygen on the rate of colour-fading. Fading, determined spectro-photometrically, of collodium films steeped in cyanine solution occurs in compressed oxygen more rapidly than at atmospheric pressure; the rate of fading is, however, not proportional to the pressure and fluctuates round a constant value at pressures of over 40 atmospheres. The cause of this constant limiting value is ascribed to the constancy between the number of the dyestuff molecules ionised by light and oxidised by the oxygen; at smaller pressures there is a lag in the latter over the former. —B.C.I.R.A.

Cellulose Acetate Silk Mixtures: Dyeing. G. Rudolph. *Kunstseide*, 1926, **8**, 13-15.

The article describes the two-colour effect obtained if a fabric composed of acetate silk and cotton is dyed with substantive colours which do not affect the silk. The multicolour effects similarly obtainable on fabrics comprising unions of acetate silk with cotton, cotton and viscose, cotton and wool, natural silk, wool and cotton are described. —B.C.I.R.A.

Dyes: Fastness to Light. H. Wagner. *Z. angew. Chem.* 1925, **38**, 1191-1195.

An account is given of the author's work on judging the fastness to light of dyestuffs employing the Hanau U-viol system of illumination by ultra-violet light. The dependence of the fastness of pigments to light on the optical properties (refractive index, &c.) of the binding material or varnish present is pointed out and the limitations of the fading method indicated. —B.C.I.R.A.

Flerhenol M: Application. R. Maxheimer. *Melliand's Textilberichte*, 1926, **7**, 143-144.

The compound combines the properties of a cold wetting agent with those of a dyestuff solvent and levelling agent. If goods to be bleached or mercerised are wetted with Flerhenol M the preliminary boil is unnecessary and the mercerised cloth has a higher lustre than boiled-out cloth. In bleaching, a better bleach is obtained in a shorter time. It obviates preliminary boiling in dyeing with naphthols, indanthrenes, and vat dyes unless very delicate shades are required. It furnishes clear stable bottoming baths even with hard water and it makes it possible to dye the dry, unboiled cloth. For a minimum addition of oil the fastness to rubbing is essentially improved and since fuller tones are obtained, dyestuff may be economised. On account of its outstanding wetting properties the use of Flerhenol M in mechanical dyeing is indicated. The compound can be used with almost all dyes, at any temperature, and in neutral, alkaline, or weakly acid baths and it improves penetration and evenness of dyeing. —B.C.I.R.A.

Indanthrene Colours. W. Sieber. *Melliand's Textilberichte*, 1926, **7**, 141-143.

The author shows that as early as 1906-1907 he replaced sodium carbonate by potassium carbonate in the printing paste used in the application of Indanthrene steam colours, and obtained more reliable results, particularly in the production of medium and pale shades, and brighter fuller colours. The method at the time was said by the Badische Co. to have no advantage, but is now widely used. The thickenings and conditions employed by the author are described. —B.C.I.R.A.

Artificial Silk: Dyeing. R. Metzger. *Melliand's Textilberichte*, 1926, **7**, 50-52.

A short general article on the dyeing of artificial silk. A pattern sheet showing a series of Indanthrene colours is provided. —B.C.I.R.A.

Naphthol AS Colours: Application. H. Lint. *Melliand's Textilberichte*, 1926, **7**, 46.

The article refers to the application of Naphthol AS colours on artificial silk. The colours are extremely fast and very brilliant shades are obtained. The artificial silk is first bottomed with the requisite quantity of naphthol solution and for this purpose is worked in a trough for 20-30 minutes at 25-30° C. and centrifuged (preferably wrapped in a cloth previously soaked in the naphthol solution) without rinsing. A diazo solution of the given base is prepared and the material is led into a bath containing the requisite quantity and worked for 15-20 minutes. The dyed material is rinsed repeatedly in cold water, once in hot water at 60-80° C., and is then soaped for 20-30 minutes at 60-80° C. in a liquor containing 4-5 grams of soap per litre. Finally, it is re-rinsed, and acetic or formic acid is added, if necessary, to brighten the shade. The colours are said to be fast to light, bleaching, washing, water, perspiration, ironing, rubbing, and wear. They are suitable for all classes of artificial silk and can be applied to the loose material, yarn, or fabric. The hardest twisted yarn is thoroughly penetrated and if the process is properly carried out uniform dyeings are always obtained. These colours are particularly important for viscose since they can stand the desulphurising process without change of shade. —B.C.I.R.A.

Cellulose Acetate Silk: Dyeing. B. Rötel. *Melliand's Textilberichte*, 1926, **7**, 43-44.

The original method of dyeing cellulose acetate silk, involving partial saponification, became obsolete on the discovery of the "developed dyes" and the "suspension dyes." Both classes are marketed under a variety of names, according to the maker. Their principal properties are outlined. —B.C.I.R.A.

The Theory of Dyeing Wool and Silk. P. Pfeiffer and O. Angern. *J. Soc. Chem. Ind.*, 1926, **45**, B402 (from *Z. angew. Chem.*, 1926, **39**, 253-259).

Benzeneazophenol forms crystalline compounds with 1 mol. of phenilalanine and of sarcosine, and benzeneazoresorcinol with 2 mols. of sarcosine. The methyl ether of the benzeneazophenol does not form such compounds, and it is concluded that salt-like combination takes place between the amino-group and the phenolic hydroxy group. Similar compounds with basic dyes could not be obtained. Sarcosine anhydride (dimethyldiketopiperazine) forms crystalline compounds with 2 mols. of benzeneazophenol, benzeneazoresorcinol, and benzeneazosalicylic acid. Azobenzene and the methyl ether of benzeneazophenol do not form such compounds, and it is probable that molecular combination takes place between the carbonyl oxygen of the amino-acid anhydrides and the phenolic hydroxyl. Sarcosine anhydride also combines with *p*-aminoazobenzine, *o*-toluene-azo-*o*-toluidene, *o*-phenylenediamine, *m*-phenylenediamine, and β-naphthylamine, but not with *p*-dimethylaminoazobenzine or dibenzyl-β-naphthylamine. These compounds are generally decomposed by suitable solvents. It is concluded that the dyeing of wool and silk is due, in general, to the formation of molecular compounds, which may, in special cases, be of salt-like character. If combination takes place only on the surface of the fibre this theory becomes similar to the adsorption theory. —B.C.I.R.A.

(J)—Printing

Coloured Discharges on Indigo: Printing. C. Sunder and R. Solbach. Pli cacheté 2171. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 755-758.

Fast coloured discharges with vat dyes on indigo grounds may be obtained more conveniently if the indigo is first discharged with hydrosulphite and the vat dye subsequently reduced to its leuco-compound by stannous hydroxide (60%). The material after printing, drying, and steaming, is passed through a bath of caustic soda, 19° Bé. at 75° C., and washed. —B.C.I.R.A.

Coloured Discharges on Indigo: Printing. J. Pokorný. Pli cacheté 2318. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 759-764.

Red and white effects on indigo are obtained by dyeing the fabric with indigo, mercerising, treating with sodium naphtholate and printing with a paste made up of powdered lead chromate, a thickening of tragacanth and starch, diazo-paranitraniline and water in the proportions stated. The material is treated with hydrochloric acid for 3-5 minutes at 37° C., steamed for 35-40 minutes at 35° C., and washed. The invention dispenses with the manganese dioxide and sodium chlorate employed by Skoupil for the same purpose and also with the autoclaving. In a criticism of the above process, the referee mentions that he detected the formation of oxycellulose in samples of the white which showed signs of yellow colouration. —B.C.I.R.A.

Katanol O: Application in Colour Printing. M. Remy. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 176-177.

It is found possible to use Katanol O in colour printing if the goods are subjected to a preliminary impregnation with the material. A solution of 15-20 grams of Katanol O per litre to which small quantities of sodium carbonate and Monopol brilliant oil have been added is suitable for the purpose. Samples so treated and subsequently printed with basic dyestuffs, using Rongalite C or other sulphoxylate discharge are furnished, and directions are given for carrying out the process. —B.C.I.R.A.

Activine in Printing; The Use of——. R. Wegener. *Melliand's Textilberichte*, 1926, **7**, 446.

The use of activine is recommended for the after-bleaching of the white ground of printed cotton and linen materials. For the colours which are less resistant to chlorine (e.g., the basic colours), a solution of 200 grams of activine in 1,000 litres of lukewarm water may be used to which is added about 200 grams of formic acid. After one treatment in this bath the bleaching effect is noted and if further bleaching be necessary a further 100 gms. of formic acid is added; the temperature may sometimes be raised a little. For colours which are fast to chlorine a stronger solution of activine may be used (e.g., 1,000 gms. activine to 1,000 litres of water) with the addition of 500 gms. of formic acid. Still more energetic action may be obtained by adding 600 gms. of hydrochloric acid of 34° Tw. and by raising the temperature. It is always advisable to try a preliminary experiment with a small sample of the material. In a similar way activine may be used for the after-bleaching of white discharges. Activine may also be used for the preparation of thickenings for printing, e.g., by boiling for 10 to 15 minutes 2,000 gms. of farina with 20 litres of water containing a little activine; to the paste thus formed vegetable gums may be added as desired. Activine is also recommended for the after oxidation of printings with vat colours in order to brighten or intensify the shade. The advantages of the use of activine are that it is an easy matter to control the percentage of active chlorine in the solutions employed (it only being necessary to weigh out the desired amount of the powder) and that there is much less danger of weakening the fibre than when hypochlorites are used. —L.I.R.A.

(K)—Finishing

Raising Machine. P. Beckers. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 60-61.

A general explanation of the action of the raising machine. This machine has 24, 30, or 36 wire-covered rollers evenly distributed round a big drum, the rollers rotating with the drum and simultaneously on their own axes. —B.C.I.R.A.

Iron Yarn Sewing Thread: Finishing. A. Heermann. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 363-365.

A general article on dyeing, starching, and glazing iron yarn used in shoe laces, trimmings, &c. The method of spinning and finishing sewing thread is also described. —B.C.I.R.A.

Raising Woven Fabrics. J. S. Heuthwaite. *Dyer and Calico Printer*, 1926, **55**, 206-207.

A discussion of factors which influence the raising of woollen fabrics with special reference to the effect of the condition (moisture content) of the fabric and its construction of weave. Different raised finishes are obtained according as the fabric is dry, damp, or wet during raising. Rotary raising machines of the Moser type are preferred to vertical and horizontal machines, and natural teazles are now largely replaced by card wires made with ordinarily tempered steel (for cotton and dry wool fabrics) and brass (for wet and damp wool fabrics). —A.J.H.

History of the Development of Special Chemical Finishing Processes for Cotton Goods; A Contribution to the——. A. Bodmer. *Melliand's Textilberichte*, 1926, **7**, 232-234.

The author reviews attempts which have been made from time to time to make use of the action of strong acids and alkalis on cotton materials in order to obtain various finishes. Samples of a fine cotton cloth of open weave treated to obtain the following finishes are given—Mercerised, transparent, opal, imago-transparent, Hecolan. —L.I.R.A.

Hosiery Finishing Machine. E. Wolff. *Melliand's Textilberichte*, 1926, **7**, 138-140.

The machine has shaping pieces of sheet steel which are directly heated with steam. The shapes are nickelled so that the hosiery is easily slipped on and off, and to protect them against oxidation, and they have interchangeable toe pieces to adjust them to various sizes. Increased production is claimed for the machine as, owing to the intense heating, drying proceeds rapidly. The pipe carrying in the steam is arranged concentrically in the outlet pipe, so that the maximum heat value is obtained from the steam. —B.C.I.R.A.

(L)—Waterproofing

Waterproof Fabrics: Manufacture. H. Jaeger. *Melliand's Textilberichte*, 1926, **7**, 149-156.

A general survey of methods of waterproofing light and heavy fabrics by impregnation with various agents. The machinery employed is illustrated and particular emphasis is laid on the advantages of the continuous process. —B.C.I.R.A.

Patents

Production of Fast Shades on Wool with Indigo or Indigo Derivatives. Durand and Huguenin, A.-G., G.P.419,061 (from *J. Soc. Chem. Ind.*, 1926, **45**, B235).

Wool is allowed to take up dehydroindigo-bisulphite compounds from an acid bath, after which the compounds are converted into the corresponding indigoid original substances by known methods. For the colour to develop, the wool, which is dyed with the bisulphite compounds, is treated with dilute sulphuric acid, or with ammonia or alkali carbonates at ordinary or at higher temperatures.

B.R.A.W. & W.I.

Process for Felting Animal Fibres, Hairy Skins, or Hair. R. Bach. E.P.243,301 (from *J. Soc. Chem. Ind.*, 1926, **45**, B314).

Aldehydes, ketones, or compounds which yield these particularly bisulphite compounds, are used alone or with other, e.g. mercury salts, as carroting agents for hair and the like. Formaldehyde is particularly suitable and may be used in the form of gas or aqueous solution and applied before or during the felting operation or to "half-planked felt (Labraz)" or these carroting agents may be added to the planking liquor. Treatment with oxidising agents is advisable after the carroting operation. For this purpose hydrogen peroxide and nitric acid are especially suitable, as apart from their function as deodorisers, they enhance the carroting effect.

Example—Hair is exposed to the action of a 5 to 15% solution of fomaldehyde (slightly acidified with, for instance, hydrochloric acid) at 25 to 80° for ½ to 40 hours, depending on the quality of the hair and the temperature and concentration of the solution. If desired, the operation may be conducted under pressure at temperature above 100°. The hair is then centrifuged and treated with hydrogen peroxide. This process improves the felting properties of the fibres and enables inferior and waste hair to be successfully used in the manufacture of hat bodies.

B.R.A.W. & W.I.

Bleaching and Dyeing of Furs and the Like. H. Stein, W. E. Austin, and I. Liebowitz. U.S.P.1,573,200 (from *J. Soc. Chem. Ind.*, 1926, **45**, B318).

Animal fibres, especially fur skins, are bleached with hydrogen peroxide solution in the presence of a fibre-protecting agent comprising ferrous sulphate, before they are dyed. B.R.A.W. & W.I.

Permanganate Bleach: Application. L. Bradley and E. P. McKeefe. Canadian P.245,496 (from *Chem. Abs.*, 1925, **19**, 711).

Fibrous material is bleached with a permanganate in the presence of sufficient acid to maintain an acid condition during bleaching, without preventing the formation of insoluble manganese compounds, and the manganese compounds are then dissolved. The permanganate may be added in a series of two or more additions.

—B.C.I.R.A.

Stain Bleaching Solutions: Preparation. H. M. Weber. U.S.P.1,522,560-561 (from *Chem. Abs.*, 1925, **19**, 877).

A solution for the removal of various stains and writing in ink is prepared by the interaction of an aqueous solution containing about 6% of sodium phosphate with about 1% of bromine. A solution for whitening textile materials, removing fruit stains, ink stains, and similar marks comprises 1-6% of sodium phosphate chlorinated with not more than 2% of chlorine.

—B.C.I.R.A.

Cloth Substitute: Preparation. M. A. Besso and F. P. Habicht. U.S.P. 1,532,648 (from *Chem. Abs.*, 1925, **19**. 1781).

Cotton or other fibrous material is suspended in a fluid such as water, the fibres are allowed to settle to form a layer and are treated with cuprammonium solution or other solvent to cause them to adhere together on localised short portions and produce a porous flexible fabric adapted for making garments, &c., which will withstand washing. —B.C.I.R.A.

Fast-to-rubbing Dyed Fabric: Production. Chemische Fabr. Dr. A. Schmitz. F.P. 592,452 (from *Chem. Zentr.*, 1926, **i.**, 241).

Fats or oils such as castor oil or olive oil are treated with sulphuric acid, the products are transferred to soap, mixed with gelatine or glue, then with carbon tetrachloride; a syrupy mass is obtained which is soluble even in cold water containing lime without the precipitation of a calcium soap. By treating dyed animal or vegetable fibres, notably cotton dyed with ice colours, in a bath containing 15-20 c.c. of the preparation per litre of water, the fastness to rubbing of the dyed material is increased. —B.C.I.R.A.

Wax Printing Mixture. M. A. Léonard. F.P.586,310 (from *Chem. Zentr.*, 1926, **i.**, 242).

A mixture of 200 g. pitch, 10 g. yellow wax, 100 g. benzene, and 20 g. turpentine oil is used for applying the pattern; the fabric is dyed at a temperature not exceeding 80°, when the coated portions remain undyed. After dyeing, the coating mixture is dissolved out with benzene or trichlorethylene. —B.C.I.R.A.

Stencilled Fabrics: Dyeing. A. Selose and G. Buyck. F.P.586,138 (from *Chem. Zentr.*, 1926, **i.**, 242).

The fabric is placed between two plates cut in the form of the pattern and the whole immersed in the dyebath. Vari-coloured designs are obtained by using different plates and a series of dyebaths.

—B.C.I.R.A.

Cellulose Acetate: Dyeing. Teinturerie de la Rize. F.P.590,738 (from *Chem. Zentr.*, 1926, **i.**, 242).

Cellulose acetate is treated with a solution of about 1 kg. of barium hydroxide and 1 kg. of barium chloride in 100 litres of water for from 15 minutes to two hours at 50-70°; after rinsing it is dyed in the usual way with substantive dyestuffs.

—B.C.I.R.A.

Lanolin Dressing and Waterproofing Solution: Application. J. Escallon. F.P. 592,406 (from *Chem. Zentr.*, 1926, i., 781).

A dressing for natural and artificial fibres consists of a solution of 300 g. water-free wool fat in 500 g. carbon tetrachloride; for waterproofing, the wool fat content is raised. The solutions may be mixed with carnauba, Japan wax, ceresin, &c., and viscous oils such as linseed oil, &c.

—B.C.I.R.A.

Ozone Loose Fibre Bleaching Plant. Maschinenfabr. Kupfermühle, G.m.b.H. D.R.P.416,772 (from *Chem. Zentr.*, 1926, i., 1296).

Textile fibres are bleached in a drying apparatus which is fitted with conveyor belts for supporting the material and with an ultra-violet light source for developing ozone from the dry air current passing through. A safe but energetic bleaching action is obtained. —B.C.I.R.A.

Fabric Oblique Rope-winding Frame. E. Mundorf. D.R.P.422,070 and F.P. 598,713 (from *Chem. Zentr.*, 1926, i., 1886-1887).

To ensure equal treatment of warp and weft in washing, milling or dyeing in rope form, the fabrics are wound obliquely on a frame so that the warp and weft threads run at an acute angle to the direction of the spiral formed by the cloth. The device for transferring the cloth from the beam to the frame is also covered by the patent.

—B.C.I.R.A.

Wetting Agents. I.G. Farbenindustrie A.-G., Frankfort-on-Main, Germany. E.P.246,468.

In the treatment of fibres and fibrous materials in cases in which soap has not been used or cannot be used, there is added to the bath an organic sulphonic acid, preferably an aromatic sulphonic acid substituted by a side chain, such as propyl or butyl naphthalene sulphonic acid, or an aromatic sulphonic acid substituted by alkylated amino groups such as dimethyl metanilic acid, diamyl-alpha-naphthyl-amino sulphonic acid, or the salts of such acids, or the condensation products of sulphonated phenols or naphthalene and formaldehyde. These acids or salts may be used for various treatments of wool, cotton, jute, leather, hair, artificial silk, paper, &c., such as oiling, sizing, desizing, filling, bleaching, and waterproofing. The acids may be used with an addition of soap or saponaceous materials. Thus, for sizing warps, &c., a suitable composition is potato starch and the sodium salt of butylated naphthalene sulphonic acid made up by boiling with water, whilst to a desizing liquor, the sodium salt of isopropylated naphthalene sulphonic acid is added.

—B.C.I.R.A.

Irreversible Colloidal Cellulose: Manufacture. S. A. Ogden, Los Angeles, California, U.S.A. E.P.246,476.

Cellulose is converted into an irreversible colloidal form by treatment at an elevated temperature, preferably not exceeding 70° C., with sulphuric acid of 40-55° Bé. After washing to remove acid, the products may be dried to give a horny mass. The product is adapted for use as a binding agent for materials such as clay, paper, asbestos, and rubber, and generally it may be used as a substitute for cellulose xanthates. It may be used as the primary material in the manufacture of cellulose nitrates, acetates, and xanthates. The process may be applied to the separation of animal fibres from mixed fabrics, the animal fibres being separated from the colloidal cellulosic material in the washing bath. —B.C.I.R.A.

Dyeing and Printing Wool, and Animal Materials. Chem. Fabr. Milch A.-G., Berlin, and K. Lindner, Oranienburg, near Berlin. E.P.246,507.

An aliphatic substituted aromatic sulphonic acid, or a salt thereof, is added as a solution to form a paste of the dyestuff, or either in the dissolved or undissolved condition to the dyebath. The addition of these sulphonic acids facilitates the wetting of the material, serves to soften the goods to be dyed, and enhances the distribution of the dyestuff, so improving the regularity of the dyeing, the tint obtained, and the fastness of the dyeing. —H.L.R.

Solubilised Azo Dyes: Application. Sandoz Chemical Co. Ltd. and A. E. Woodhead, Bradford, Yorks. E.P.246,609.

Raw cotton and cotton yarns and materials which have been treated with concentrated alcoholic soda and then with *p*-toluene-sulphochloride or other sulphochloride, as described in Specification 195,619, are dyed by means of insoluble or difficultly soluble dyes which have been solubilised by pre-treatment with higher fatty acids or their sulpho or other derivatives or salts thereof as described in Specification 219,349; sulphoricinoleic acid, or oleic, stearic, or palmitic acid or their alkali or ammonium salts are suitable solubilising agents. A large number of dyes are specified. Mixed goods containing the treated cotton may be dyed and the solutions may be mixed with the usual thickening agents and printed on the treated cotton. —B.C.I.R.A.

Hank Drying Apparatus. H. Haas, Lennep, Rhineland, Germany. E.P.246,655.

Hanks are suspended in trucks and conveyed through a drying tunnel through which downward currents of air are circulated by fans located in the bottoms of heating compartments adjacent to the tunnel. Additional inlets from the heating compartments to the tunnel may be provided. —B.C.I.R.A.

Cloth Printing Machine. H. Desmarest, Rue Lauriston, Paris. E.P.246,794.

Fabric from a roll is fed by friction between an endless conveying band and a hollow cylindrical stencil within which is arranged a device for supplying ink, paste, gum, &c. The ink is passed through the stencil by a spring-pressed roller, the fabric being supported at this point by an arcuate plate arranged below the conveying band. The stencil is mounted in sliding bearings so as to press on the fabric by its own weight, and the band is coated with emery powder to increase its grip on the fabric. The stencil is rotated from a driving wheel by means of a spring-pressed roller having knurled ends or provided with toothed wheels to engage hoops or teeth on the stencil. To produce spaced patterns, the inking device may be fixed to the cylinder so as to rotate therewith. A brush may be employed in place of the ink-supplying device, and the stencil may be made in the flat and then rolled into cylindrical form. —B.C.I.R.A.

Cellulose Acetate Fabric: Finishing. Silver Springs Bleaching and Dyeing Co. Ltd. and A. J. Hall, Timbersbrook, Congleton, Cheshire. E.P.246,879.

The lustre of textile materials, films, and other products composed wholly or partly of cellulose acetate, is preserved in processes such as bleaching, dyeing, printing, and steaming, involving the use of temperatures above 85° C., by carrying out the treatment in the presence of a solution of a protective salt of an adequate concentration which usually lies between 10-30% strength. A large number of salts is mentioned. The process is applicable to the treatment of union fabrics, to the discharging of dyed cellulose acetate fabrics, and to the production or relief of latent strains in cellulose acetate fabrics or products. —B.C.I.R.A.

Cellulose Acetate: Dyeing. British Dyestuffs Corporation, Ltd., J. Baddiley, A. Shepherdson, H. Swann, J. Hill, and L. G. Lawrie, Blackley, Manchester. E.P.246,984.

The process of Specification No. 224,077 for dispersing insoluble or substantially insoluble colouring matters having affinity for acetate silk by means of sulphonated naphthalene-formaldehyde condensation products is modified in one of two ways—(*a*) By reducing the proportion of dispersing agent to less than 1% in a paste containing 10% of dyestuff, or (*b*) by using the dispersing agent completely neutralised with ammonia. In an example of the first modification a 10% paste of aminoanthraquinone contains 1/4% of dispersing agent. —B.C.I.R.A.

Cloth-expanding Roller. Maschinenfabrik Benninger A.-G., Uzwil, Switzerland. E.P.247,173.

In a cloth-expanding roller comprising bobbins mounted to rotate on anti-friction bearings on a curved shaft, the inner race rings of the bearings are prevented from rotating relatively to the shaft but are capable of longitudinal movement thereon. The inner race ring of the bearing is rigidly mounted on a conical sleeve which is formed with an inwardly bent portion forming a key engaging a groove in the shaft so that the sleeve can slide but not rotate on the shaft. Alternatively, the shaft may be provided with a key engaging a recess in the sleeve or in the race ring. —B.C.I.R.A.

Aniline Black Coloured Resists: Printing. I.G. Farbenindustrie A.-G., Frankfort-on-Main. E.P.247,211.

Coloured resists under Aniline Black are produced by padding the material in a bath such as is generally used for Aniline Black, printing with the ester of a leuco vat dyestuff, and finishing in the manner usual in Aniline Black dyeing. The esters of leuco vat dyestuffs are more easily oxidised than the aniline. According to an example, material is padded with aniline, printed with a paste consisting of Indigosol O_4B, starch tragacanth, and neutral ammonium oxalate, steamed, and finally passed through a weak bath of potassium dichromate. —B.C.I.R.A.

Cellulose Ester Solutions: Preparation. L. Lilienfeld, Zeltgasse, Vienna. E.P. 247,223.

In the manufacture of articles or products such as coatings, finishes, sizes, artificial leather, cements, thickening agents for pigments in textile printing, plastic compositions, films and artificial threads according to the process of Specification 231,805, the solution of the cellulose xanthofatty acid is prepared by means of a mixture of water and at least one phenylamine derivative, produced by the introduction of univalent hydrocarbon radicals into the amino group, such as a monoalkyl derivative of aniline or of a homologue thereof, in particular, mono-methylaniline. It is not necessary that the phenylamine derivative should be soluble in water. —B.C.I.R.A.

Insecticides and Fungicides: Preparation. S. W. Kendall, Ealing, London. E.P. 247,242.

Cellulosic or other vegetable, animal, metal or other materials are protected against insects, animals, or vegetable growths by treatment with compounds having as a base radical a rare earth metal or thorium, thallium, titanium, zirconium, or uranium, and as acid radical a higher organic acid, the percentage of the compounds in the solutions, emulsions or suspensions used being, in the case of textile and like materials, such as to preserve the absorbent characteristics of the materials unchanged. The materials may be impregnated or the compounds may be applied by double decomposition. The compounds may be used as ingredients of insecticides

or fungicides, or of anti-fouling compositions or paints. Suitable compounds and their preparation are indicated and among the examples described are—(1) Treatment of woollen fabrics for moth protection with a solution of lanthanum stearate in benzol or of thorium oleate in white spirit, or successively with solutions of sodium stearate and cerium chloride. (2) Treatment of woollen rugs for protection against carpet beetles with a solution of titanium abietate. (3) Treatment of timbers.
—B.C.I.R.A.

Drying Cylinder Doll Head Valve. N. Isherwood, Salop Street, Bolton. E.P. 247,311.
The doll head at either or both ends of a steam-heated drying cylinder forming a unit of the usual fabric drying machine is provided with a three-way valve for controlling the flow of steam and air either to or from the cylinder. The valve may be a rotary plug valve which allows steam to flow through the usual passages in the supporting framework of the machine, either to or from the cylinder, but which may be adjusted to shut off the steam supply and admit air to the cylinder.
—B.C.I.R.A.

Mordant Dyes: Application. W. Eberlein and Colloisil Colour Co. Ltd., Bredbury, near Stockport, Cheshire. E.P.247,328.
Textile materials are dyed or printed with the silicates of basic dyes obtained by interaction of a basic dye with a colloidal suspension of a natural or artificial fixing silicate or earth. The material is either first impregnated with the silicate suspension and then with a solution of the dyestuff, followed by precipitation of the colour lake, or the silicate and dyestuff are first mixed, preferably in the presence of a protective colloid such as glue, casein, or albumen, to prevent precipitation, and the material impregnated with the mixture which is thereupon precipitated in the fibre. The precipitation may be effected in known manner, such as by heat or addition of an electrolyte. If albumen or the like is present in the silicate suspension, formaldehyde or hexa-methylenetetramine is advantageously added to the dyestuff solution so as to bring about coagulation on steaming. Some examples are given. —B.C.I.R.A.

Fabric Folding Machine. J. Nanterre, Lyons, France. E.P.247,528.
The fabric passes through a tensioning device, over an inspection board, in front of a screen, over a driven measuring roll and through an oscillating guide which causes the fabric to be folded over the hinge of a folded table. —B.C.I.R.A.

Emulsions: Preparation. I.G. Farbenindustrie Akt.-Ges., Frankfort-on-Main, Germany. E.P.247,588.
Emulsions are prepared with the aid of an aromatic or partially hydrogenised aromatic sulphonic acid containing aralkyl residues or aryl+aliphatic residues of any kind; suitable sulphonic acids are those derived from benzylbutyl-naphthalene, &c., and those comprising both an oleic acid residue and aromatic side chains which are obtained by a joint sulphonation of oleic acid with hydrocarbons of the type phenylnaphthalene occurring in high-boiling tar oils. Examples are given. An emulsion suitable for use in scouring is obtained by treating certain turpentine oil residues with any of the naphthalene sulphonic acids, benzylchloride, butyl alcohol, and a sulphonating agent, and diluting with water.
—B.C.I.R.A.

Hank Treating Vat Travelling Apparatus. J. Brandwood, Southport, A. Stocker, and Twyver Works, Ltd., Millbrook Street, Gloucester. E.P.247,661.
In apparatus for treating hanks with liquids, the hank-supporting rollers are fed in successive steps from one end of a frame in a tank to the other by placing their ends on travelling belts. Stops on either side of the roller ends are arranged so as to be automatically lifted at regular intervals with respect to the frame. The rollers are rotated by the belts until the stops are lifted, when they are moved forward a step by the belts to positions between a new pair of stops when the latter descend.
—B.C.I.R.A.

Soluble Magnesium (Zinc) Substantive Dye Compounds: Preparation. The late E. Knecht, Marple, Cheshire, and E. F. Müller, Uxbridge, Middlesex. E.P. 247,694.
Water-soluble zinc or magnesium compounds of substantive cotton colours for dyeing and printing textile fabrics are obtained by mixing aqueous solutions of the dyestuffs with solutions of zinc or magnesium salts in the presence of ammonium salts, substituted ammonia or sodium bicarbonate. With ammonium salts free ammonia is added except in the case of salts of volatile acids. Alternative methods of preparing the dyebath are described. —B.C.I.R.A.

Ozone Hank-bleaching Apparatus. E. Crespi, Bergame, Italy, and M. P. Otto, Paris. E.P.247,738.
After prelimminary treatment with a weak acid, fibres are bleached by the action of a mixture of ozonised air and water vapour. The air, drawn in by a fan and dried in a tower is ozonised, passed through a meter and a coke washer having a water spray supplied from a valved conduit, to a bleaching tunnel. A certain amount of water vapour is drawn through. The skeins to be bleached are carried on rails on trucks propelled through the tunnel. The rails may be rotated to expose all the skein area to the ozone. The ends of the trucks are provided with flaps engaging the interior of the tunnel and with

staggered holes to ensure circulation of the ozone. —B.C.I.R.A.

Yarn Dyeing Resists: Application. S. W. Clarke and J. R. Browne, Lancaster. E.P.247,757.

The resist is a paste containing two parts by weight of slab glue, one part of gum arabic, and two parts of flour and is applied by soaking in it soft thread, string, or tape and winding it round the part of the yarn to be resisted. The resist is allowed to dry before dyeing and is then removed by washing. To produce variegated effects a thin string prepared with the resist may be tied tightly round the hank at those places where two colours are intended to meet. After the resist has dried the parts of the hanks between the tight string loops are bent into a loop and each is dipped into a different colour. The resist may also be employed on fabrics. Dye may be added to the hot resist mixture when that part of the yarn or fabric which comes in contact with the coloured resist is dyed as well as protected from subsequently applied dye. —B.C.I.R.A.

Textile Drying Tunnel. H. L. Julien, Rue Gaucheret, Brussels. E.P.247,783.

The goods are subjected during their passage through the drying kiln to the circulation of three successive and differently directed currents of air of decreasing temperature and humidity. The drying tunnel is formed with two sections having central and side slotted partitions and a third having a slotted floor and ceiling, the air being circulated transversely from the centre to the sides and from the sides to the centre by fans in the first two sections. In the third section the air is drawn upwardly through the floor and ceiling and then recirculated by a fan having a damper controlled outlet for moisture-laden air. Heaters are provided in the air paths. —B.C.I.R.A.

Leuco Vat Dyes: Preparation. J. Morton and others, of Morton Sundour Fabrics, Ltd., Carlisle. E.P.247,787.

Vat dyes are rendered soluble in water or dilute alkali by treatment with an alkyl sulphuric halide in the presence of a metal and an organic base and with or without a diluent. The reaction may be carried out in one stage or the vat dyestuff, organic base and metal may be first boiled together and the reaction mixture treated with the alkyl sulphuric halide; the reaction is facilitated by adding acids or acid salts to the mixture of dyestuff, metal and base. The primary reaction products may be extracted with dilute alkali and water-soluble compounds isolated from the filtrate by salting out, &c. The process is applicable to indigoid dyestuffs and to benzanthrone, indanthrone, &c., dyestuffs. A large number of suitable dyes, metals, organic bases, and acids or acid salts are specified in the examples. —B.C.I.R.A.

Mercerising Range. C. A. Gruschwitz Akt-Ges., Olbersdorf, Saxony. E.P.247,909.

For the removal of lye during mercerising the material is taken from a drum, passed over guiding rollers and is laterally stretched during travel through a horizontal run during the course of which the material can be inspected; it then enters a hot water washing tank placed at a lower level and fitted with a system of rollers upon which the material makes a number of superposed passes. The material is finally carried to squeezing rollers in front of which there may be a spraying apparatus. The fabric is collected immediately on drums or passes to an acid process. —B.C.I.R.A.

Suction Fibre Wetting Apparatus. J. A. H. Itier, Lyons, France. E.P.247,975.

The penetration of fibres by degumming, bleaching, washing, rinsing, or dyeing liquids is obtained by first applying suction to the fibres and then introducing the treating liquid into the vat and applying gas pressure. After release of the pressure the liquid is preferably circulated by means of a pump; this circulation may be vertical or air or gas may be used to stir the liquid. —B.C.I.R A.

Sulphonic Acid Resists: Preparation and Application. I. G. Farbenindustrie Akt-Ges., Frankfort-on-Main, Germany. E.P. 248,007.

In dyeing union fabrics the wool or silk is reserved during the dyeing of the cotton by treatment with an aromatic sulphonic acid or a partly hydrogenised aromatic sulphonic acid which is joined to a residue by a bridging bi-valent non-metal, for example, carbon, oxygen, or sulphur; the residue may itself be sulphonated. Suitable sulphonic acids are obtained by condensing hydrocarbon sulphonic acids with sulphur chloride and in other ways specified. In illustration, a half-wool material is first dyed with Naphthol Yellow S.E.L. to dye the wool, and after rinsing, the cotton fibre is dyed in a bath containing Dianil Pure Blue PH and as the reserve, sodium dinaphthyl sulphonate. The method of preparing the sulphonic acid resists is covered by the patent. —B.C.I.R.A.

Thermoplastic Cellulose Derivative Proofing Agents. C. Dreyfus, London. E.P. 248,147.

Waterproof or gasproof compound fabrics are formed by uniting under appropriate conditions of temperature and pressure, woven, knitted or other fabrics composed wholly or in part of filaments of a thermoplastic cellulose derivative, with fabrics composed of filaments of a non-thermoplastic or relatively non-thermo-plastic material such as silk, cotton, linen, &c. Union of the component fabrics may be assisted by first coating the fabric composed of the cellulose derivative with

softening agents or solvents therefor, and by applying pressure. For example, a fabric made entirely of cellulose acetate yarn is treated on the face to be associated with a silk or other fabric, with a solution of 20 grams of monomethyl-xylene-sulphonamide in 100 grams of benzol for each 100 grams of cellulose acetate, and the associated fabrics are passed slowly through heated calendar rollers at 100-180° C. under a pressure of 300-600 lb. per sq. inch. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Printing—

246,873. S. Calning. Fabric stencilling apparatus.

Finishing—

247,398. J. Harrison and J. Jeffrey. Cloth folding device.

247,931. Maschinfabrik Benninger A.-G. Cloth expander.

248,029. E. Farrell. Cloth expander.

5—LAUNDERING AND DRY CLEANING

Textile Fabrics: Laundering. P. Krais and K. Biltz. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 92-93.

The conclusion of a previous research on the action of washing and bleaching materials on fabrics. Handkerchiefs washed ten times with (*a*) soap powder, (*b*) bleaching powder, (*c*) Activin, (*d*) Persil, are least tendered by Activin, which has disinfectant as well as bleaching properties. The tendering effect was judged from tensile strength measurements on a Schopper tester. —B.C.I.R.A.

Clouding Point of Soap Solutions. —. Braun. *Brit. Chem. Abs.*, 1926, **45**, B135 (from *Chem. Ztg.*, **49**, 1012).

The clouding point is defined as that temperature at which a soap solution containing 3% of fatty acid (as soap) becomes turbid. In washing textiles, if the clouding point is above that of washing, soap is deposited on the fabric. An apparatus for the determination of the clouding point is described. —B.L.R.A.

Toxicity of Hydrogenated Products. J. Pohl. *Seifensieder Zeitung*, 1925, **52**, 680 (from *Zentralbl. f. Gewerbehygiene d. Kunststoffe*).

Tetralin has only a weak toxic effect; hexalin and methyl hexalin, up to 10% addition to soap has no considerable effect. —B.L.R.A.

Patents

Stain-removing Compound: Preparation. B. Kaul, Neckargerach, Baben, Germany. E.P.247,414.

Finely cut soap is dissolved in hot soda solution and a solution of 10-20 parts of acid oxalate of alkali and 20-25 parts of potash added. The mixture is boiled and stirred to form a paste. The stain is covered with the paste and after a time washed out on an absorbent support. A stain-removing soap is referred to, comprising ordinary washing soap, soda, potash, acid oxalate of potassium, ox-gall and triple vinegar. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Laundering—

246,629. Troy Laundry Machy. Co. Washing machines: Wear plate for latch band.

247,463. A. Dunsmore. Turbine drive for washing machine.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Dibromo-2.4-phenylhydrazine, the Three Iodophenylhydrazines and their Combinations with Aldehydes and Ketones. V. E. Votocek, B. Loppova, and V. Ettel. *Bull. Soc. Chim. de France*, 1926, **39-40**, 278.

The products of the interaction of 2-4 dibromophenylhydrazine and various sugars are described. This reagent serves to identify galactose or arabinose in presence of other sugars, but cannot be used to separate galactose from arabinose. The products of interaction of *o*, *m*, and *p*-iodophenylhydrazines and various sugars are also described. —L.I.R.A.

Gelatin: Hardening. (1) A. Brylinski and (2) P. Brandt. *Bull. Soc. Ind. Mulhouse*, 1925, **91**, 611-614.

(1) If commercial 50% ammonium sulphoricinate (2-4%) is added to gelatin (10% solution melted) in the presence of formaldehyde (3%) the gelatin is rendered insoluble in 1½ hours in the cold or in a few minutes at 40-50° C. (2) In criticism of the above it is stated (*a*) that ammonium sulphoricinate in contact with formaldehyde yields hexamethylenetetramine which is harmful to the fabric, and (*b*) that the action of ammonium sulphoricinate is not specific and is at most a physical one. —B.C.I.R.A.

Magnesium Chloride Solutions: Hydrolysis. C. G. Schwalbe and R. Schepp. *Ber.*, 1925, **58**, 2500-2502.

Further work on the conversion of lignified tissues into coal is described which indicates that the presence of vegetable fibres facilitates the hydrolysis of aqueous solutions of magnesium chloride. —B.C.I.R.A.

Warp Threads: Density Determination. A. Hamann. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 153-154.

Notes on the different methods of counting the number of warp threads per unit width

of Jacquard fabrics and a means of determining from the warp and weft density of a finished fabric its warp and weft density when in the loom. —B.C.I.R.A.

Cotton: Staple Test. W. Kuske. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 238-241.

The staple diagrams and frequency curves of a number of samples of American, Egyptian and Indian cottons are given. The curves were obtained with a Baer sorter employing the method described by Frenzel. —B.C.I.R.A.

Wool Fibres: Action of Light. P. Krais and K. Biltz. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 305-306.

A study of the action of light on wool fibres in relation to hair diameter. Single hairs from undyed tops, from tops dyed with indigo, and tops dyed with indigo and after-chromed or otherwise treated were exposed to light under the conditions described and the tensile strength and extensibility determined for fibres of measured diameter. With fine fibres the tensile strength remains fairly constant on exposure but there is a marked decrease in the extensibility figures. This falling off is greater for undyed than for dyed fibre, which fact affords further evidence of the protective action of dyes on fibres. —B.C.I.R.A.

Standard Methods for the Simple Testing of Woollens. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 421.

A brief outline of the types, nature, and properties of woollen goods, followed by standard methods for identifying and testing the threads of a woollen fabric; for testing the weight, degree of shrinkage, acid and alkali content; for the fastness of the dyes to light, friction, and washing; and for resistance of the fabric to friction and stretching. —B.L.R.A.

Bleached Cotton: "Boiling-off Number." —. Angele. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 480-481.

A method of examining bleached fabrics for damage by over-bleaching consists in boiling a sample of the goods with caustic soda solution, which dissolves out the damaged cellulose portion. The solution is filtered, acidified, and titrated with N/10 potassium permanganate. The number of c.c.'s required to oxidise completely the organic matter dissolved out from 1 gram of the goods is known as the "boiling-off number." A standard boiling off number of 10-12 has been adopted in many laboratories. Directions for carrying out the determination are given. —B.C.I.R.A.

Sulphoricinates and Turkey Red Oil: Wetting Power. G. Bernardy. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 18-20.

The comparative wetting power of oil solutions is measured by carefully laying a strand of yarn 4 cms. in length on the surface of 100 c.c. of a 1% oil solution (calculated in terms of total fatty acid content) contained in a 100 c.c. beaker, or by dropping the strand from a height of 1 cm., and measuring the time interval between the contact of the strand with the surface and its sinking below the surface. The temperature (preferably room temperature) is kept constant. Results with cotton strands for a number of wetting agents, including Turkey Red oil compounds, Monopol soaps, &c., are tabulated and show that ammonium sulphoricinate is a better wetting agent than sodium sulphoricinate, that in general the ammonium compound is the more effective, and that the addition of 0·1% ammonia solution to 100 c.c. of a 1% solution of a wetting agent has a favourable effect in considerably decreasing the time of sinking. By reducing the fatty acid concentration to one half the original concentration the sinking time is increased three to four-fold. —B.C.I.R.A.

Faulty Cotton Cloth: Testing. —. Angele. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 22-23.

Tests are given for detecting faults in cotton goods due to (*a*) the presence of iron, copper, lead, calcium, starch, and dextrins, mineral oil, free chlorine, and caustic soda; (*b*) tendering due to the formation of oxycellulose and hydro-cellulose. The methylene blue test for oxycellulose is not favoured. —B.C.I.R.A.

The Torsion of Jute and other Bast Fibre Yarns. H. Rudolph. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 53-54.

The author gives an account of the application of Marschik's twisting technique to the examination of jute yarns. A fixed length of yarn, for instance 5 cms., is twisted until it breaks. The additional twist divided by the original twist is known as the torsion ratio and is said to give useful indications as to the "quality" of the yarn, its softness, and the character of the spinning operation. —L.I.R.A.

"Texl" Fabric Testing Electroscope. Hackländer & Co. *Melliand's Textilberichte*, 1926, **7**, 20.

A piece of wool fabric is rubbed with a rubber rod and the static electricity produced is transferred from the rubber to a double spherical conductor which leads inside a small housing and is insulated with amber. A fine silver tongue hangs opposite the inner sphere of the conductor and is held in a state of tension when the conductor is fully charged. The fabric to be tested is applied to the external sphere of the conductor and by observing the movement of the tongue on a disc in the side of the housing it is possible to distinguish between silk, wool, cotton, artificial silk, and all types of mixed fabrics. —B.C.I.R.A.

Fibre Strength Tester. F. Rühlemann. *Papier-Fabr.* (Verein Zellstoff Ing.), 1926, **24**, 1-6.

A new method of measuring accurately the tensile strength and extensibility of individual cellulose fibres is described in detail. The "Deforten" balance tester, which measures the mass of water required to break the fibre, is embodied in the apparatus. To ensure constant loading the water is introduced into the balance pan container through a tube from a burette arranged in the way described. A special method of mounting the fibre is shown. The extension of the fibre during loading is followed with a kinematograph; to follow the increase in extension with time, time intervals of one second are registered on the kinematograph film by means of a metronome so arranged that the pendulum obscures the microscope objective once a second. Curves for unbleached and bleached wood cellulose fibres are given. —B.C.I.R.A.

Paper Stiffness Tester. H. Schulz and W. Ewald. *Papier-Fabr.* (Verein Zellstoff Ing.), 1925, **23**, 768-770.

A convenient device for measuring the stiffness or rigidity of a sample of paper is described with its application. A strip of paper is held in a clamp so designed that when otherwise free the strip takes up the form of a cylindrical curve. A second clamp carries a bolt by means of which a definite load can be applied to the middle point of the strip. The distance between the two clamps is variable. The upward displacement of the paper strip on the sudden removal of the load is read on a scale. —B.C.I.R.A.

Paper: Electrical Properties. M. Speter. *Papier-Fabr.* (Verein Zellstoff Ing.), 1926, **24**, 119-120.

In a note on the electrification by friction of paper strips, a table is given which shows the sign of the charge acquired by the paper when rubbed with cotton, wool, leather, &c., and when the paper is resting on a number of different surfaces such as cotton and silk fabrics. —B.C.I.R.A.

Clays: Particle Size. R. Lorenz. *Papier-Fabr.* (Verein Zellstoff Ing.), 1925, **23**, 753-759; 1926, **24**, 33-36, 74-76, and 91-92.

The experimental methods employed in determining particle size in clays and other filling materials are now described. —B.C.I.R.A.

The Content of Pure Wool Fibre in Raw Wool. E. Schuelke. *Melliand's Textilberichte*, 1926, **7**, 121.

The author works out a practical and simple method for estimating the amount of pure wool fibre in raw wool. The amount of nitrogen is determined, which represents about 13-16% of the pure wool fibre according to the breed of the sheep. About 1 kg. of raw wool is disintegrated and 30 gr. of this is treated with hot water and filtered. The residue is then placed in a weighed porcelain basin and covered with 20 c.c. conc. sulphuric acid and warmed until the fibres dissolve to a syrup. Sufficient gypsum is then added to bring the weight to 100 g., whereby a dry powder is produced which may be used for the Kjeldahl method of determining the percentage of nitrogen in 10 g. of this (corresponding to 3 g. raw wool). B.R.A.W. & W.I.

Proteins of Wool. S. R. and E. R. Trotman and W. R. Sutton. *J. Soc. Chem. Ind.*, 1926, **45**, 20-24T.

The authors have not been able to confirm the statement made by Raikov, that wool evolves sulphur dioxide when treated with phosphoric acid, nor have they been able to isolate Allwoerden's "elasticum" and J. Mueller's "gelatin." No volatile sulphur compounds were obtained from the solution of wool in sodium hydroxide. A comparatively soluble residue is obtained when wool is digested with hydrochloric acid, which will dissolve readily in ammonia. From the hydrochloric acid solution and the undissolved residue, protein (called A and B) could be obtained with sulphur content respectively, 3·67% and 1·49%. After removing protein A from the hydrochloric acid solution, a third was obtained by saturating the filtrate with magnesium sulphate. It is considered from the results of experiments made with cold acids and alkalis on wool, that protein A is possibly present in the epithelial scales and protein B chiefly in the cortex. Protein A seems more susceptible to the action of oxidising agents than protein B and this agrees with the practical experience in the chlorination of wool. Protein B being more readily soluble in alkalis is possibly connected with the damage by alkalis. B.R.A.W. & W.I.

Sulphur Content of Wool. S. R. Trotman and H. S. Bell. *J. Soc. Chem. Ind.*, 1926, **45**, 10-12T.

Published results for the sulphur content of wool vary from 0·5 to 5%. Whether keratin be either a single protein or a mixture of proteins one would expect it to have a definite and not a variable composition. Variation in results may be due partly to faulty methods of analysis. The authors have examined many published processes, compared with that of Carius, and recommend the following modification of the Benedict-Denis method (*J. of Biol. Chem.*, 1909, 363, 1910, 401). About 0·2 g. of the wool is digested with pure sodium hydroxide solution made from metallic sodium till it has just dissolved. A drop of bromine is added, and after a few minutes, the mixture is neutralised with nitric acid, 10 c.c. of the Benedict-Denis reagent are added, and the determination

of the sulphuric acid is completed in the usual manner. Different purified wools, of known origin, were analysed by this process. The percentage of sulphur showed but little variation, 3·42% being the maximum, whilst the average of 40 experiments gave 3·22%. It is held that the sulphur content of wool is not variable as supposed hitherto, but practically constant.

—B.R.A.W. & W.I.

Bending Test for Rope Yarns; Development of a Standard——. *Text. Rec.*, 1926, **43**, No. 517, p. 98.

The principle involved in this machine is the same as that in the Brewster's rope yarn bending apparatus. The specimen is held in a cylindrical clamp having rounded jaws and the tension is applied by means of a weight. Bending is produced by rotating the clamp through an adjustable angle, about a horizontal axis. The machine contains five of these bending units and the most satisfactory angle of bending is found to be 90°. It is important in taking a specimen to use a double clamp, which preserves the original twist in the yarn. —L.I.R.A.

Faintly Acid Fibre: Testing. E. Ristenpart. *Chem. Zentr.*, 1926, **i.**, 272 (from *Z. ges. Textil-ind.*, 1925, **28**, 460).

The test material is laid dry on a microscope slide, one drop of distilled water is added and allowed to soak in, after which, dry reagent paper is laid on and covered with a second slide. A load of 1 kg. is then applied. On 1 g. of fibre, 0·001 milligram of acetic acid or sulphuric acid may be detected with litmus paper, 0·019 mg. of sulphuric acid with Congo paper. The test can be made into a quantitative colorimetric one. —B.C.I.R.A.

Viscosity of Colloid Solutions in the Structural, Laminar, and Turbulent Regions. W. Ostwald and R. Auerbach. *Kolloid Zeitschrift*, 1926, **38**, 261-280.

The author describes a form of capillary viscometer which may be used to investigate the turbulent flow and laminar flow regions of the velocity pressure curve for viscosities of dispersed systems. The viscometer consists of a very long graduated tube connected with the capillary, which is connected with a large glass reservoir by pressure tubing. Various conditions are attained by altering height of liquid, capillary dimensions and shape. The pressure range obtainable varies from 1 to 1,000 corresponding to a velocity of flow variation of 1 : 1,000,000 (different capillaries being used, if necessary). A variation of the viscometer, for use in the structural flow or low pressure region is shown. The accuracy of results and reproducibility of conditions were tested by determining the absolute viscosity of water in the region of the laminar flow. Satisfactory results were obtained and are discussed with numerous others obtained with colloid systems. Anomalous results for certain sols are explained by the existence of turbulence in the structural flow region as well as in the normal turbulence region. This phenomenon is thought to result from rupture taking place in the elastic structure of such sols.

—L.I.R.A.

Cellulose Sols; Viscosity Anomalies of——. W. v. Neuenstein. *Kolloid-Zeitschrift*, 1926, **39**, 88-90.

The behaviour of sols of cellulose and its esters, as regards viscosity measurements, is discussed. Certain of these sols show a decrease in viscosity on ageing, but mechanical treatment of the aged material is followed by a rise. The author thinks it inadvisable to apply a hypothesis similar to that current in explaining the viscosity alterations in retrograding starch mixtures. He supposes instead that the decrease in viscosity results from an orderly grouping and orientation of the rod shaped elementary colloid particles and the increase takes place when these aggregates are again disintegrated into irregular groupings.

—L.I.R A.

Clays: Plasticity. —. Pfefferkorn. *Chem. Zentr.*, 1925, **i.**, 2401 (from *Sprechsaal*, 1925, **58**, 183-184).

It is shown that the plasticity of a clay is not dependent on its content of humus substances. The author found that the plasticity of a number of clays was not diminished after he had destroyed the humus substances by oxidation and subsequent extraction with organic solvents. The removal of the bituminous substances from a plastic oily ceramic clay did not effect its plasticity. The author's results confirm Keppler's assumption that plasticity is in general higher the smaller the size of the separate particles, and, in his view, the plasticity of clays is directly proportional to the content of clay substance and of colloidal silica and inversely proportional to the size of the clay particles.

—B.C.I.R.A.

Fischer-Bauer Viscosimeter. (1) E. Sembach. (2) E. P. Bauer. *Chem. Zentr.*, 1925, **i.**, 2404 (from (1) *Sprechsaal*, 1925, **58**, 198-200; (2) *ibid.*, p. 169-170).

(1) The application of this viscosimeter to determinations of the viscosity of kaolin suspensions is described. The viscosimeter consists in a metal sphere suspended on a very fine wire carrying a counterweight at the other end and supported on a cylinder. The time taken for the sphere to sink through a measured distance of the suspension to be tested gives a relative measure of internal friction and therefore of viscosity of the suspension. The marked effect of small quantities of soluble constituents on the viscosity of suspensions is evident from the experiments.

(2) The viscosimeter is used to determine the setting time of clay slips.

—B.C.I.R.A.

Pectin; A Modification of the Calcium Pectate Method for the Estimation of——. A. M. Emmett and M. H. Carre. *Biochemical J.*, 1926, **20**, 6-12.

It is shown that the precipitation of pectin by neutral 95% alcohol is an unreliable method of estimation of the pectin content, as no precipitation occurs in dilute solution. Alcohol, acidified by hydrochloric acid precipitates pectin from aqueous solutions at practically all dilutions. The free acid is not easily washed away and the pectin is best estimated by redissolving in water and subsequently precipitating as the calcium salt. —L.I.R.A.

Colour: Measurement. L. C. Martin. *Chem. Age*, 1926, **14**, 181.

Discussing the problem of colour measurement the author emphasises the need for standardisation. A standard method of illumination is particularly necessary and brief mention is made of some possibilities. —B.C.I.R.A.

Sugars; Determination of Reducing, by Means of Fehling's Solution with Methylene Blue as Internal Indicator. J. S. Mann. *J. Soc. Chem. Ind.*, 1926, **45**, 187.

Lane and Eynon's method of estimating reducing sugars in syrups is open to the disadvantage that the indicator, Methylene Blue, is readily oxidised by air. It is suggested that Dianol Green (B.D.H.) is a more suitable indicator, being less readily oxidised. —L.I.R.A.

Glycerol in Cotton Cloths and Sized Yarns; The Detection and Estimation of——. G. Smith. *J. Text. Inst.*, 1926, **17**, T187-T191.

Wear-testing Machine for Fabrics. A. J. Amsler. *Text. Mfr.*, 1926, **52**, 54.

This machine is for measuring the resistance to wear of fabrics of any kind, especially cloth, bolster covers, upholstery, &c. The wear is produced by pulling a strip of fabric, which is held tensioned by a predetermined constant load to and fro, through a comb until it breaks. The number of to and fro movements up to the moment of fracture is automatically counted, and this number, together with the load on the strip, is the measure of the resistance to wear. The comb consists of four steel plates, each 2 mm. thick, arranged to give the cloth a zig-zag path. —L.I.R.A.

Cellulose and Regenerated Cellulose: Zymolysis. P. Karrer. *Melliand's Textilberichte*, 1926, **7**, 23-24.

Results previously described are discussed in relation to the ultimate structure of cellulose and artificial silk. The very considerable differences in the rate of zymolysis of the different artificial silks are ascribed to differences in the micellar structures and therefore in the active surfaces of the products. The following figures show the comparative resistance of various types of cellulose to snail cellulase—

Type of cellulose	% decomposition in 6 days
Scoured cotton	2·1
The same cotton mercerised ...	10·2
Cellulose from purest filter paper	7·1
Cuprammonium silk, 120 den....	30·8
Cellulose from cellulose acetate	70·0

Thus, processes which cause a loosening of the micellar structure of cellulose decrease its resistance to zymolysis. Natural cellulose is hydrolysed only to the extent of 20-25% by snail cellulase and the hydrolysis is not carried further by the addition of a fresh amount of enzyme. It appears, therefore, to consist of two constituents which behave differently towards enzymes. Herzog has shown that regenerated and mercerised celluloses have different X-ray spectrograms from that of natural cellulose. The behaviour of the products to snail cellulase suggests that the explanation is other than a structural chemical change in the cellulose molecule during the processes of solution and alkali treatment. Hydrolysis with snail cellulase provides a very sensitive method for detecting differences between the various types and varieties of cellulose. —B.C.I.R.A.

The Gelatine or "Elasticum" of Wool. *Melliand's Textilberichte*, 1926, **7**, 257 (from *Rev. Gen. Teint. Impr. Blanch. Appr.*, 1925, **3**, 697).

Several investigations have been carried out concerning the "elasticum" of wool, without so far fully explaining the nature of this combination. After boiling pure wool in distilled water for some time, a gelatinous substance is taken up by the water, which is about 1·5% of the wool. In the dried condition this is a horn-like structure and is soluble in water, not in alcohol. Its solution does not produce ammonia on heating with a solution of caustic soda. With chromate the substance becomes insoluble, it favours the fixing of chromate but delays the reduction of the mordant. Lead acetates precipitate the gelatine of the wool, but not ordinary gelatine. For more exact investigations about the relation of the wool gelatine to the ordinary gelatine, wool which is served as raw material is carefully washed with soap and soda, with weak acid water, ether, diluted ammonia, and pure water, and then extracted with distilled water. The solution obtained is evaporated to dryness and leaves a brown acid residue in contrast to the usual alkaline residue. A comparison of the behaviour of both gelatines with the usual precipitant then follows. With basic dyes the wool gelatine gives insoluble colour lakes, but with acid and substantive dyes no precipitate. Wool gelatine consists at least of three different substances, of which one is precipitated by means of baryta and the two others by means of tannin

solution. It is worthy of notice that the wool itself is dyed blue with watery emulsion of insoluble night blue base. With sodium plumbate the solutions of wool gelatine give a precipitate which turns brown when heated, a proof that its sulphur is contained in the same form as in wool. Ordinary gelatine, although it contains sulphur, does not give this reaction. Finally a summary of the character of the wool gelatine is given and the way in which it differs from ordinary gelatine and size. —B.R.A.W. & W.I.

Analytical Method to Establish the Change which takes place in Wool during its Manufacture. *Melliand's Textilberichte*, 1926, **7**, 256 (from *Rev. Gen. Teint. Impr. Blanch. Appr.*, 1925, **3**, 701).

The author gives an account of the methods which have been suggested by different investigators, to establish the changes and likely damages to wool, which occur in the different processes, e.g., in mordanting, dyeing, carbonising, singeing, &c. M. Becke has suggested two methods, one of which is based on establishing the quantity of albuminoid substance which went into solution at the treatment concerned by means of the Biuret reaction and the other depends on determining the quantity of liberated sulphur of the wool fibres by means of stannous chloride. O. Sauer determines the nitrogen which has become soluble in the alkaline hydrogen superoxide. The relation of this nitrogen quantity to the total nitrogen is a measure for the degree of change which the wool has experienced by means of some external chemical influence. Such an action occurs, e.g., very clearly under the influence of sunlight, and under this influence the quantity of soluble nitrogen increases much more rapidly with raw wool than with dyed wool. —B.R.A.W. & W.I.

Efflux of Plastic Substances. B. Marzetti. *Science Abs.*, 1926, **29**, A672 (from *Atti. R. Accad. Lincei.*, 1925, pp. 169-173).

In a previous paper it has been shown that for unvulcanised rubber Poiseuille's law does not hold, the efflux over a considerable range being proportional to the square of the pressure. In this paper is investigated how far this quadratic relation applies. In the case of a 1:4 solution of rubber in benzene Poiseuille's law holds, but a 1:2·34 solution obeys the quadratic relation. A more satisfactory solvent for the more accurate work is a heavy mineral oil and a table is given comparing the rates of efflux under different heads of a rubber oil mixture of the proportions 1:17 and a castor oil of the same order of viscosity. The castor oil obeys Poiseuille's law, while the rubber mixture departs from it to an even greater extent than is indicated by a quadratic expression. There is approximate linearity in the lower range of pressures. The type of motion as judged by inspection of minute floating particles is a streamline one, with the axial part moving with an increasingly high velocity as the pressure rises. The effect seems to be explainable in terms of a reduced viscosity for high rates of shear. —L.I.R.A.

Cotton and Kapok; Differentiation of——. A. Lejeune. *Analyst*, 1926, **51**, 265 (from *Bull. Soc. Chim. Belg.*, 1925, **34**, 419-421).

Kapok is coloured yellow and cotton is unaffected by an aqueous solution of aniline sulphate. After immersion in a 10% solution of potassium iodide containing 5% of iodine, and subsequently in concentrated sulphuric acid, or, better, in a cooled mixture of 4 vol. sulphuric acid, 1 of water and 1 of glycerin, cotton is coloured blue-black and kapok yellow-brown. Iodine in potassium iodide solution to which zinc chloride has been added produces similar colourations. These tests cannot be used for the approximate determination of the two kinds of fibres in mixtures and the colouration in the aniline sulphate test is not very pronounced. Since basic triphenylmethane colours have a selective preference for kapok, it is possible to distinguish kapok and cotton in a mixture by placing the material in a boiling neutral bath of Malachite Green, followed by a slightly ammoniacal bath of Oxamine Red which is at boiling point, but is not boiled after immersion of the fabric. Under these conditions kapok is stained dark green and cotton bright red and an approximate determination of their proportions is practicable. —L.I.R.A.

X-ray Investigation of Cellulose and Lichenin. E. Ott. *Brit. Chem. Abs.*, 1926, **128**, A387 (from *Helv. Chim. Acta.*, 1926, **9**, 31-32).

Cellulose hydrate, obtained by recipitation of cellulose from phosphoric acid, oxycellulose, obtained from viscose by the action of potassium permanganate (completely soluble in 10% alkali, copper value 3, acid value 0·46) and hydrocellulose, obtained from viscose by the action of sodium amalgam (completely soluble in 10% alkali), give Röntgen diagrams identical with that of lichenin, showing that the crystalline constituents of these substances are identical. The conversion of cellulose into reserve cellulose (lichenin) is regarded as change of modification only. The variety of chemical agents bringing about a common result makes chemical change improbable. —L.I.R.A.

Use of Reduction Methods of Analysis, particularly Determination of the Copper Number, in determining Bleaching Damage. H. Wenzl. *Brit. Chem. Abs.*, 1926, **128**, B269 (from *Woch. Papierfabr.*, 1925, **56**, 994-997, 1024-1027).

The copper number of bleached cotton material is not an accurate criterion of the deterioration produced by bleaching unless

considered together with tests of tensile strength. The solubility of oxycellulose increases with the alkalinity of the bleaching liquor. The most rapid and trustworthy method for determining the copper number is that of Schwalbe and Hagglund (Fehling's solution is used), and those modifications involving the use of ferric sulphate or simplified apparatus are less satisfactory. The changes which occur when Fehling's solution is heated may be very much reduced by the use of pure reagents and apparatus by which the overheating of the solution is avoided. —L.I.R.A.

A New Reagent for Wood and Vanalin. J. Gruss. *Physiological Abs.*, 1926, **10**, 549 (from *Ber. deut. bot. Ges.*, 1920, **38**, 361-368).

Vanadic acid in a solution of phosphoric acid colours lignified sections yellowish-brown in 48 hours, or in less time if heated. Non-lignified structures do not give this reaction. The above solution is also a reagent for vanilin. The action of various vanadium solutions is investigated, and a substance $C_{26}H_{46}O_{10}$ is extracted from pine shavings. —L.I.R.A.

Pectin. A. Mehlitz. *Chem. Zentralblatt*, 1926, **i.**, 1620 (from *Konserven-Ind.*, 1925, **12**, 607-608).

The hydrolysis of pectin to pectic acid by means of dilute caustic soda solution in the calcium pectate process of estimation is complete in seven hours. After 30 minutes some 90% of the pectin has been hydrolysed. —L.I.R.A.

Artificial Silk Fabric: Shiny Places. "Wiederkehr." *Melliand's Textilberichte*, 1926, **7**, 41-43.

Shiny patches in artificial silk fabrics may be traced to the fact that the thread has been stretched during reeling and winding. Precautions to be taken in preparing artificial silk for these processes are discussed. Good results are obtained with an "elastic swift" designed by the Soc. de la Viscose Suisse; it has resilient double rods connected by leather cross-pieces. Stretching during winding is eliminated in a machine built by the Maschinenfabrik Schweiter A.-G., in which a device is provided which disengages the winding spindle as soon as the permissible tension in the thread is exceeded. —B.C.I.R.A.

Tetracarnite and Eucarnite: Estimation. *Melliand's Textilberichte*, 1926, **7**, 98.

The value of Tetracarnite, Novocarnite, Blankite, and similar trade compounds cannot be determined by analytical and technical tests, as it depends on the particular purpose for which the compound is applied. Such compounds should be tested under the conditions of application. A means of estimating the value of these products numerically will shortly be published. —B.C.I.R.A.

Cellulose: Action of Ammonia. G. Bernardy. *Z. angew. Chem.*, 1925, **38**, 1195-1197.

Ammonia solution (22%) dissolves alkali-soluble cellulose. At higher temperatures and pressures cotton changes to black, amorphous substances,and at 200° and at a pressure of 40 atmospheres for 48 hours becomes brittle and decomposes to a brown powder. Notwithstanding, the fibre shows under the microscope at each stage the typical external intact structure of unattacked cellulose. Furfurol content, copper number, swelling power, and fat content are unchanged: the nitrogen content rises with increasing temperature and pressure to a maximum of 20%. The action of ammonia (22%) on raw cotton and on wax-free cotton is similar to but less intensive than the action of sodium hydroxide. Although 22% ammonia does not cause swelling, even at low temperature, considerable swelling occurs on treatment with liquid ammonia at -33-35°, and no degradation of cellulose is observed. The product has a copper number of only 0·166; the number expressing the degree of swelling is 4464, as compared with 5168 for cellulose swollen with sodium hydroxide. —B.C.I.R.A.

Flour Moisture: Estimation. J. Tausz and H. Rumm. *Z. angew. Chem.*, 1926, **39**, 155-156.

An improved form of direct distillation apparatus for the determination of water in flour and other organic substances. The chief advantage of the method is the substitution of a liquid of high boiling point for the light inflammable substances previously used in this estimation. The authors use tetrachlorethane. A table of water determinations for a number of organic substances by the distillation method and by drying shows results in good agreement. The estimation takes ¼ to ¾ hour, according to the substance to be tested. —B.C.I.R.A.

Artificial Silk: Tensile Strength and Extensibility. P. Krais. *Z. angew. Chem.*, 1925, **39**, 196.

Measurements of the tensile strength and extensibility of single filaments of viscose under different humidity conditions were made on the special apparatus constructed by the Keyl Company. The tensile strength in damp air of filaments of mean diameter 35μ decreased by 25% and the extensibility increased by 30%. Filaments immersed in water at 22° C. showed a loss in tensile strength of 41·3% and an increase in extensibility of 20%. Measurements with yarn of 195 denier in the wet and dry condition showed when wet a decrease in tensile strength of 57% while the extensibility remained practically the same. —B.C.I.R.A.

Cellulose: Degree of Swelling. G. Bernardy. *Z. angew. Chem.*, 1926, **39**, 259-261.

Measurements of the Schwalbe hydrolysis number may be employed to determine accurately the degree of swelling of a sample of cellulose, if the usual apparatus is slightly modified and the determination carried out under the carefully controlled experimental conditions described in detail in the article. —B.C.I.R.A.

Titanium Trichloride Solution: Potentiometric Standardisation; and Copper: Estimation. E. Zintl and A. Rauch. *Z. anorg. Chem.*, 1925, **146**, 281-288.

Notes on the conditions to be observed in standardising potentiometrically titanium trichloride against potassium dichromate, iron alum, or copper sulphate. The copper method described affords a means of estimating copper in the presence of mercury, lead, cadmium, zinc, and arsenic. —B.C.I.R.A.

Sols: Particle Orientation. H. Zocher. *Z. anorg. Chem.*, 1925, **147**, 91-109.

A study of spontaneous structure-formation in sols. Sols with an orderly parallel arrangement of colloidal particles are obtained on cooling hot concentrated solutions of Benzopurpurin 4B and Chrysophenine. In old vanadium pentoxide and iron hydroxide sols anisotropic colloidal particles are formed in a similar parallel arrangement. In vanadium pentoxide sols the particles are rod-shaped and associate in pairs, in iron hydroxide they are disc-shaped. The discs are of such distance apart that they give rise to interference colours. In a magnetic field the system is anisotropic and reflects polarised light. —B.C.I.R.A.

Ozone: Estimation. H. v. Wartenberg nd G. v. Podjaski. *Z. anorg. Chem.*, 1925, **148**, 391-396.

The estimation of ozone in such dilution as is found in ventilating systems (0·1-1 mg/cub. metre) is conveniently carried out by drawing 1-2 litres of air in 5-15 minutes through 2-3 ccm. of potassium iodide solution in the simple form of apparatus described. The solution is titrated with thiosulphate or with arsenious acid in presence of sodium bicarbonate with a degree of accuracy of 5-10%. Ozone is more soluble in organic liquids than in water and the solubility follows Henry's law. The solutions are fairly stable. —B.C.I.R.A.

Titanium Trichloride Solution: Potentiometric Standardisation. I. M. Kolthoff, O. Tomiček, and C. Robinson. *Z. anorg. Chem.*, 1926, **150**, 157-162.

Potassium dichromate is the most useful titration reagent since it measures the iron content as well as the strength of titanium chloride solutions. The balance point is established more rapidly if a small quantity of copper sulphate is added when the end point is nearly reached. Titration with copper sulphate alone gives only a small deflection and a somewhat too low titer. These errors are obviated by the addition of potassium thiocyanate solution, but the use of copper sulphate is not recommended. —B.C.I.R.A.

Amines and Diazo Compounds: Potentiometric Estimation. E. Müller and E. Dachselt. *Z. Elektrochem.*, 1925, **31**, 662-666.

The authors describe a satisfactory potentiometric determination of the end point in diazotising processes and in the estimation of amines. The solution of the amine for diazotising is contained in a glass vessel, since nitrous acid in a platinum vessel sets up a definite potential difference. The sodium nitrite solution is run into the amine solution and the potentiometer balanced in the usual way against a Zero Poggendorf electrode according to the Ostwald method. A normal-calomel electrode (Hg/Hg_2Cl_2, N-KCl) is convenient and is connected with the diazotising vessel through an electrolytic key filled with N-KCl solution. The reaction vessel is stirred electrically. The author's results for a number of typical diazotising processes (with aniline, *m*-xylidine, &c.) are given and the resulting curves interpreted. The method is practicable for technical purposes if the zero electrode is replaced by a system at known potential. —B.C.I.R.A.

Cellulose and Lichenin: Constitution. R. O. Herzog. *Z. physiol. Chem.*, 1926, **152**, 119-124.

The Röntgen spectographs of lichenin and of a regenerated cellulose, β-cellulose, were compared, and the two were found to be similar but not identical. This held especially for the intensity of the interferences. It may possibly be assumed therefore that lichenin and β-cellulose are nearly related, that they are not uniform substances, but that the main constituent substance is identical in the two. Possibly native cellulose is a secondary product resulting from a primary product, namely, that contained in lichenin and β-cellulose. —B.C.I.R.A.

Rubber Hardness Testers. R. Houwink. *Zellstoff u. Papier*, 1926, **6**, 79-81.

The Schopper Hardness Tester, the Plastometer of Pusey and Jones, and the Durometer of Shore, used for testing the hardness of the rubber coverings of paper and textile rolls, are described. In the three instruments, the depression brought about by the pressure into the rubber surface of spheres or pins is measured. Rubber coatings are divided into hard and soft, the degree of hardness being dependent on the thickness of the rubber layer up to a

critical thickness. Curves showing the absolute hardness at critical thickness for a number of samples of rubber are given. —B.C.I.R.A.

Paper Stiffness Tester. *Zellstoff u. Papier*, 1926, **6**, 77-78.

A measure of the stiffness of a sample of paper is obtained by clamping a strip of specified dimensions in front of a sheet of paper on a drawing board standing vertically. The height of the strip at the jaws of the clamp is marked on the paper. The paper bends under its own weight, and the position of the free end is also marked. The horizontal distance of this point from a vertical passing through the first marked point is a measure of the stiffness of the paper. For each sample of paper four strips must be cut, two lengthwise, two transversely according to the grain, and the mean of the four readings taken. A table showing stiffnesses, tearing lengths, and extensions for a number of different papers shows no definite relationship between the three constants. —B.C.I.R.A.

Artificial Silk Fabrics: Streakiness. R. O. Herzog. *Melliand's Textilberichte*, 1926, **7**, 43.

The causes may be chemical or physical. Those of a chemical nature include the presence of residual foreign substances due to insufficient washing. Physical non-uniformity is much more frequent and the influencing factors are—(1) The absolute size of the cellulose particles and the distribution of the different sizes, (2) the mutual arrangement of the particles and the distribution of the binding material, (3) the surface of the fibre, (4) the presence of capillaries, fissures, &c. Each of these factors influences the reflection of light and the absorption of dyestuffs. The absolute size of the particles can be maintained constant by using homogeneous cellulose and uniform conditions of mercerising and ripening. Irregular distribution of the cellulose particles in the thread occurs when celluloses subjected to different mechanical treatments are used, when different charges are mixed for the formation of the thread, when the spinning solution is not sufficiently frequently filtered, &c. The mutual arrangement of the particles and the distribution of the binding substance is most regular in artificial silks spun by the stretch spinning process. The surface of the fibre depends on shrinkage processes and on ageing phenomena. The lustre depends primarily on conditions of thread precipitation; its further development depends on the after-treatment of the thread, i.e., on the stretching, drying, soaping, &c. The presence of capillaries is due to the presence of small bubbles of air in the precipitation of the thread and to fissures caused in the subsequent processes. In this connection the repeated moistening and drying of the fibre plays a considerable part. Both processes further the hysteresis of the thread. By repeated swelling and shrinking the fibre ages, the framework of the particles thickens and cracks occur, giving rise to irregularities and reducing the active surface. To avoid streakiness the maximum attention should be given to the uniformity of the raw material and working processes. Elasticity tests afford a convenient method of control. —B.C.I.R.A.

Plasticity. A. de Waele. *Kolloid-Zeitschrift*, 1926, **38**, 27-32.

The author discusses experiments on plastic bodies in relation to theories which he has evolved from theoretical grounds in a previous paper. With heterogeneous substances the linear type of curve for pressure and velocity of outflow is absent. The curve which has been obtained has been interpreted differently by different workers. Bingham establishes the curve as hyperbolic, but the author testing experimentally found no constant asymptotic value for the equation, as would be expected at very high shear values according to Bingham. Experimental results showed no tendency to alteration in curvature after the low values of pressure are passed. The character of the pressure-volume function in a heterogeneous system is considered mechanically, three types of flow being evident in the form of the surface of the emergent plastic, (*a*) at high pressure flow is parabolic, (*b*) at very low pressure the flow is "solid," and at slightly higher pressures than (*b*) a mixed flow occurs. These three states correspond with three well-defined regions of the pressure volume curve. Observation of the annular service of the plastic substance during rotation in the MacMichael instrument is instructive. The static yield value (K) at low pressures is discussed, the constant maximum value (*f*) being characteristic for the material, and an equation for the yield value (F) with varying dimensions and under different dynamic conditions is derived. The difference between (F) and (*f*) is connected with the discontinuity of shear in the system, apart from the gradual discontinuity which is based on the mechanism of heterogeneous flow: The return of static elasticity after a period of rest is considered and the author suggests that the return of static cohesion between the particles is opposed by the viscous phase between them and that the occasional coagulation of a plastic system on shearing is caused by the transitory orientation of the particles in two planes. —L.I.R.A.

Nitrocelluloses: Absorption of Gases and Denitration. D. Costa. *Chem. Zentr.*, 1926, **i.**, 34-35 (from *Gazz. Chim. Ital.*, 1925, **55**, 540-548.)

The products formed by the adsorption of ammonia by gun cotton

$$(C_{24}H_{28}[OH]_2[ONO_2])$$

and the breaking down of these to new products which in turn adsorb ammonia

are described. The final result is complete denitration, the product having the composition $C_{24}H_{20}O_{10}$. The paper deals also with the adsorption of ammonia by cellulose decanitrate and by collodion, and with the adsorptive power of nitrocelluloses for hydrochloric acid, sulphur dioxide, carbon dioxide, hydrogen, and oxygen.
—B.C.I.R.A.

Hank Girth Measure. J. Brüx, Chemnitz. *De Textielindustrie*, 1925, **6**, 1298-1300.
A simple but precise appliance is described. It is claimed to be particularly useful in the control of mercerisation.—B.C.I.R.A.

Patents

Yarn Regularity Tester. J. E. G. Lahousse. U.S.P.1,517,911 (from *Chem. Abs.*, 1925, **19**, 404).
Successive lengths of textile thread to be tested are passed under a known tension between two points of attachment at one of which vibrations of known frequency are imparted to the thread. The distance between one of the points of attachment and one of the nodes of the vibrating thread is measured and serves as an indication of the weight of the thread.
—B.C.I.R.A.

7—BUILDING AND POWER

(B)—Fire Prevention

Cotton Cellulose: Spontaneous Combustion. F. Taradoire. *Compt. rend.*, 1926, **182**, 61-63.
Cotton takes fire spontaneously in contact with air at a temperature of 210-220°; in contact with drying oils and dryers a temperature of 210° causes spontaneous combustion. It is found that the rapid oxidation of the drying oil is retarded to a greater or less degree if organic compounds such as phenols, quinol, aniline, and its derivatives are added to the treated cotton in quantities of 1%. Powdered sulphur (2%) also retards oxidation, but only becomes active after the temperature has reached 100°. —B.C.I.R.A.

(C)—Power

Print Works. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 177-178, 217-219, 310-312.
An illustrated account of a modern cloth printing works operating on electrical power, giving tables showing separately the power consumption and the requisite floor space for the various machines used in sewing, bleaching, printing, dyeing, and mordanting, finishing, and in the workshops. The lay-out considered is for a daily production of 30,000 metres. The relation between the length of cloth printed and the diameter and speed of the pressure rollers for the ordinary 1-10 colour processes is expressed graphically.
—B.C.I.R.A.

Boiler Plant. K. Gehrenbeck. *Melliand's Textilberichte*, 1926, **7**, 196-199.
An economical boiler plant for dyeworks is described in which the exhaust steam is utilised to heat water, the hot water then being available for use in the dyehouse, so that the time required to prepare the dye liquors is considerably shortened.
—B.C.I.R.A.

(D)—Lubrication

Lubricating Oils: Evaporating Properties. L. Wöhler and J. Dierksen. *Z. angew. Chem.*, 1926, **39**, 16-20.
A study of the evaporating properties of mineral lubricating oils in connection with their use in metal air filters of the Delbag-Viscin-Ring type. Curves showing the relation between evaporation losses and temperature, flash point, time, &c., are given. The conditions necessary to the formation of oil vapour and oil mists were investigated and the fact established that these conditions are not fulfilled in normally charged oil-moistened air filters. It is highly probable that the observed oiling of turbogenerators is due to the lubricating oil of the turbine or to oil vapours sucked in from the oil-laden air steam.
—B.C.I.R.A.

(F)—Lighting

Carbon Arcs: Light Flux. J. Rey. *Compt. rend.*, 1925, **181**, 1133-1134.
Experiments on the amount and distribution of light emitted by carbon electrodes having a core of rare earth salts show the existence of several zones becoming brighter from the edges to the centre of the arc. The average amount of light over the whole area of the crater is 296·3 candles per sq. mm. for a current density of 0·75 ampère per sq. mm. These figures are considerably below those given by the makers of the carbons. —B.C.I.R.A.

Artificial Sunlight Lamp. H. Biel. *Wascherei Zentralblatt*, 1926, **25**, 234.
Mention is made of a new artificial sunlight lamp. It is an arc lamp with tungsten electrodes in an atmosphere of nitrogen and is said to resemble ordinary sunlight in the ultra-violet region more closely than the mercury vapour lamp, besides being cheaper than the latter. It is known as the Skaupy lamp. —B.L.R.A.

Mercury Vapour Lamps. H. George. *Chem. Zentr.*, 1926, **i.**, 730-731 (from *Z. Instrumentenkunde*, 1925, **45**, 504-505).
The two new lamps, made of quartz glass, differ from the usual type in that they contain argon, helium, or neon. Lighting by alternating current is much facilitated if the gas pressure is about 1 cm. of mercury. The light emitted from the lamps shows a

continuous spectrum in which the mercury lines are visible but not those of the rare gases. Two lamps are described with illustrations, a small one for alternating current and a larger one for direct current lighting. —B.C.I.R.A.

Photometer. C. Pulfrich. *Chem. Zentr.*, 1925, **ii.**, 218 (from *Physikal. Ber.*, 1925, **6**, 923; from *Z. Instrumentenkunde*, 1925, **45**, 35-44, 61-70, 109-120).

A new form of photometer designed to convert the physiologically equidistant sensititivity scale of Weber-Fechner-Ostwald, the graduations of which are much closer together for high than for low intensities, into a scale having, at least in its middle part of graduation intervals of nearly equal size. The optical parts of the apparatus consist of a monocular double telescope focussed on infinity, with a distance of 6 cm. between the axes of the two objectives. Two suitably arranged right-angled prisms, by double reflection, project upwards through the common ocular two real images, the exit-pupils of the telescope, with their centres accurately coincident, which are perceived by the eye as two half circles with a sharply defined line of separation. To use the apparatus as a photometer a fixed quadratic screen is placed below one of the objectives and a similar variable screen below the other; the aperture of the variable screen is altered by means of a screw thread. The apparatus may also be used for colour and turbidity measurement, as a colloidometer, colorimeter, and comparison microscope. —B.C.I.R.A.

(H)—Humidification

Photometer. C. Pulfrich. *Chem. Zentr.*, 1926, **i.**, 1238 (from *Z. Instrumentenkunde*, 1925, **45**, 521-530).

An apparatus accessory to the photometer designed by Pulfrich, which allows of the direct comparison of light of any colour, is described. —B.C.I.R.A.

Humidity in Closed Spaces; The Measurement of——. Engineering Ctte. of the Food Investigation Board; Dept. of Scient. and Industrial Research; *Special Report*, 1925, No. 8.

The chief portion of this pamphlet is concerned with the dewpoint, wet and dry bulb, and hair hygrometers. Details are given of models of these types specially constructed to conform with unusual conditions such as low temperature, confined space, and distance from the observer. Exhaustive experiments are described for the determination of the reliability of these instruments. The dewpoint hygrometer was found to be the most suitable for observations at low temperatures. The hair hygrometer is liable to important errors if subjected to large changes of temperature or humidity. —L.I.R.A.

Fibrous Insulating Materials: Dielectric Losses. S. Setoh and Y. Toriyama. *Sci. Papers Inst. Physical and Chemical Research* (Tokyo), 1926, **3**, 283-323).

The authors have investigated the effect of humidity on the dielectric properties of the common fibrous insulating materials and curves are given for a number of insulating papers, silk, &c., which show that dielectric losses increase at first slowly—then more rapidly with increase in atmospheric humidity. A formula is established for dielectric losses in fibrous materials, and the influence of such factors as power factor, frequency, &c., are discussed. —B.C.I.R.A.

Importance of a Definite Regulation of Atmospheric Humidity in Industrial Textile Processes. J. Obermiller. *J. Soc. Chem. Ind.*, 1926, **45**, B312 (from *Z. angew. Chem.*, 1926, **39**, 46-51).

It is essential to maintain a definite and comparatively high relative humidity of the surrounding air for the spinning and weaving processes. The regulation of the temperature is less vital. The relation between the relative atmospheric humidity and the moisture content of wool, raw silk, fibroin, artificial (viscose) silk, and cotton is shown by means of curves. These are all very similar and are roughly linear between about 10% and 75% relative humidity. At a given relative atmospheric humidity the moisture content of the various fibres shows but slight variation with temperature. Cotton, a vegetable fibre which contracts when wetted, shows an increased strength in the wet state, whereas the reverse is true for animal fibres, such as wool and silk and also artificial silks, which lose strength when wetted. —L.I.R.A.

(I)—Ventilation

Dusty Air: Purification. Lehme, Engel, and Wenzel. *Melliand's Textilberichte*, 1925, **6**, 778 (from *Zentr. Gewerbehygiene*, Vol. 1, part 2).

The adverse effect of floating or accumulated dust on the health of workers is discussed and various general methods for removing it by suction or causing it to be deposited are mentioned. A recent method of depositing dust from air or gases depends on the use of a high tension electric current. The method works well and up to 99% of the total dust is deposited. —B.C.I.R.A.

Ventilation of Textile Mills. C. L. Hubbard. *Text. Mfr.*, 1926, **52**, 63-64.

The author describes methods of applying to mills and factories the results of recent work on the effect of atmospheric conditions on human well-being. It has been found that the suitability of the air depends rather on its physical state than on its chemical composition, as had previously been thought the case. Thus the relative

humidity, temperature, and rate of movement of the air have a far more potent influence on a human being than does an excess of carbon dioxide. —L.I.R.A.

Dust Measuring Apparatus. W. Allner. *Z. angew. Chem.*, 1925, **38**, 1170-1171.

A new method of measuring the dust content of air and industrial gases is described. In principle the apparatus consists of a pipe in which the dust-laden air current is flowing with a velocity of *V* metres per second; a suction pipe for drawing a portion of the main air current through the apparatus and a manometer to record the pressure in the two pipes. The pressure in the main current, and in the suction current is maintained the same by adjusting the speed of air suction through the apparatus. —B.C.I.R.A.

Patents

Humidifier. T. Andrew, Oliver Street, Stockport. E.P.246,589.

In humidifying systems in which liquid is atomised by compressed air and sprayed into an atmosphere in which humidity is required, the pressure of air in a pipe which after preliminary regulation by a valve controls a valve directly governing the flow of water through a pipe, is regulated by a supplementary valve under the control of lengths of catgut, &c., exposed to the atmosphere. —B.C.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Hemp in German Economic Life; The Role of——. J. Freudenthal. *Faserforschung*, 1926, **5**, 61.

The author reviews the extent of hemp cultivation in various countries before the war and shows its rapid decline in Germany, as well as in many other countries. He gives general information on the method of its cultivation and states that it can be made financially profitable, especially as it can be grown on low-lying marshy ground, which would not support any other crop except potatoes. The growing and spinning of hemp would be valuable as a rural occupation in remote parts and the author suggests that the import of cotton into Germany might be halved by the use of the cottonised fibres of hemp as part substitute for cotton. Thus the extensive development of hemp cultivation would lead to far reaching social and economic results, but in its early stages it would need financial help from the Ministry. —L.I.R.A.

Textile Industry: Standardisation. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 191-194.

The author discusses the advantages to be gained by the introduction of standardised textile machinery and of machinery that is specialised for particular purposes. He advocates the appointment of a Standardisation Committee to study the question of raising the quality and output of textile materials by the use of standard methods of production. —B.C.I.R.A.

Flax Manufacture; Uniform——. N. Farmakowsky. *Faserforschung*, 1926, **5**, 186-192.

To overcome the present crisis in the linen industry and to enable flax to become once more a successful rival of cotton, the author declares that the cost of production must be considerably reduced and all by-products utilised. To accomplish this he advocates the carrying out in one factory of all the processes between the harvesting of the flax and the output of the finished article. He describes the necessary machinery and lays emphasis upon the mechanical carrying of the flax from one stage to another, thereby avoiding the losses due to handling. —L.I.R.A.

Flax Cultivation in Italy. F. Tobler. *Faserforschung*, 1926, **5**, 200-202.

The author gives an account of the increasing development of the flax industry in Italy during the last few years. More attention is being given to spring sown flax in place of the winter flax formerly grown and Dutch white blossom appears to be the favourite variety. —L.I.R.A.

Textile Machinery: Production. *Engineering*, 1926, **121**, 129-130.

Statistics of employment, exports and imports for 1922-1925 are quoted and discussed with reference to 1913 as an index year. The conclusion is drawn that British manufacturers may expect a slow improvement followed later in 1926 by a check due to severe competition. —B.C.I.R.A.

Canadian Hemp Growing; Encouraging——. *Text. Merc.*, 1926, **74**, 380.

A plant for the manufacture of twine is being erected in the Province of Manitoba. As a means of encouraging the industry the Manitoba Department of Agriculture and the company putting up the plant will share jointly the expenses of a field man, who will select the land on which the hemp is to be grown and assist the farmers in harvesting the crop at the proper time. Operations will start at an early date on several hundred tons of hemp grown in 1925. It is understood that the firm will manufacture the classes of commercial twines in general demand and later make additional lines. —L.I.R.A.

Flax; Ford's Experimental Work on——. *Text. Merc.*, 1926, **74**, 488.

The Ford Motor Co. are continuing their research work on the utilisation of flax for motor car upholstery and other kindred purposes. Large purchases of flax have been made in Russia of all the varieties

grown in that country, with a view to determining what kinds of Russian flax will suit best the requirements of the company. This research work is also being undertaken from the agricultural standpoint in the hope of developing more uses for a flax crop in Russia and in America. Investigations are also being carried out in the uses of chemical machinery for the reduction of flax stalks to essential fibres. —L.I.R.A.

Linseed; The World's Production of——. *Internat. Crop Report and Agric. Statistics*, 1926, **17**, 70-73.

Tables are given showing the area and world production of linseed for 1925, together with corresponding figures for 1920-24 and also for the pre-war period 1909 to 1913. From these data it is seen that the area in 1925 for the countries taken into account is almost similar to that in 1924 (18,714,000 acres against 18,606,000 acres). Some changes have taken place, however, in the distribution of area. There are small decreases in Canada, United States, India, and Argentina, but an increase in the European area and principally in the Soviet Union. The production in 1925 shows an increase of 14% on that of 1924. It is pointed out that after 1921, the most critical year for linseed cultivation, when both area and production suffered a heavy decline, there has been a constant increase in acreage, so that the 1920-24 average is only 10% below the pre-war average whilst the area in 1925 exceeds it by 21%. The 1920-24 production average is equal to the pre-war average, whilst that of 1925 exceeds the pre-war average by 48%. Argentina represented in 1925 about one-third of the world's area under cultivation, against little more than one-quarter during the pre-war period. The percentage of the world's production as furnished by Argentina rose from 28·7% in the 1909-1913 period to 46·1% in 1920-24 and 46·7% in 1925. Of the linseed producing countries the chief exporters during the post-war period have been Argentina, India, and Canada. For the current year the quantities of the new crops available for export from these three countries are higher than those of 1925, this being due especially to the exceptional crop in Argentina. —L.I.R.A.

Operatives: Selection. B. Quiel. *Melliand's Textilberichte*, 1926, **7**, 69-71.

The assistance of psychology in selecting suitable operatives for the textile industry is discussed and some tests applied for the purpose are described. —B.C.I.R.A.

Cotton Prices in Australia (Queensland). *Australian Cotton Grower, Farmer, and Dairyman*, 1925, **1**, No. 11, pp. 5, 8, and 9.

Prices for the 1925-26 Class D of Queensland cotton are to be guaranteed at $3\frac{1}{2}$d. a lb. full 1 to $1\frac{1}{8}$ in. and 4d. a lb. for good $1\frac{1}{8}$ in. and upward. These prices represent about $9\frac{1}{2}$d. and 1s. a lb. for lint in the Liverpool market, ginning, classing, transporting, and merchanting expenses excluded. Liverpool prices at about 10d. a lb. for Middling American must therefore represent a loss to the State Government. The loss may, however, be worth while if cotton growing can be established on a firm footing in Australia. Many farmers' complaints about the 1925-26 prices are, however, reported. —B.C.I.R.A.

Cotton in Australia: Guaranteed Prices. *Australian Cotton Grower, Farmer, and Dairyman*, 1925, **1**, No. 10, p. 9.

The Queensland and New South Wales Government guarantee prices for 1925-26 range from $2\frac{1}{2}$d. a lb. seed cotton for *XXX*. (equivalent to good ordinary), 1 in. staple and downward, to 5d. a lb. for a (middling, fair, strict, good, middling) of staple good $1\frac{1}{8}$ in. and upward. Prices for 21 different classes in all are given. —B.C.I.R.A.

Cotton in Queensland: Cultivation Experiments. G. Evans. *Reports on Experimental Work on Cotton.* Brisbane, 1926, 48 pp.

This publication gives the results of experimental work carried on at the Callide Cotton Research Station, the Monat Creek Cotton Farm, and Gatton Agricultural College, during 1924-1925. Details are given of experiments on methods of soil cultivation, rotations, sowing dates, spacing, thinning, &c. Special attention was paid to the study of ratooned cotton as compared with the annual crop. In all the experiment stations it was found that the growing of any type of ratoon or standover cotton gave very unsatisfactory results. In the ratooned plots, the lower branches of the plants spread over the ground and interlaced, making it difficult and expensive to check weed growth. The yield of bolls was low and the cost of picking high as compared with that for annual cotton. When the costs of all the cultural operations are considered for both annual and ratoon cotton, it is found that the former gives a much higher profit per acre than the ratooned crop. —R.W.M.

Surat Cotton 1027 A.L.F.: Cultivation in India (Bombay Presidency). India Central Cotton Committee, *Abstract Proceedings 11th Meeting*, 1925, pp. 4-44, 66-76.

The Co-operative Societies in that portion of Gujerat south of the Nerbudda have desired the Agricultural Department to propagate and distribute pure seed of Surat I.A., which under present market conditions they find more profitable. It is inferior to 1027 A.L.F., but has a higher ginning out-turn; and as it benefits from the reputation of "farm cotton" a relatively high price is received. A discussion

by the Indian Central Cotton Committee and the Co-operative representatives on a resolution to maintain 1027 A.L.F. throughout, is reported in detail. The resolution was finally carried unanimously. Owing to the action of Local Governments, who by an extensive grant of licenses permit the movement of cotton by road into the Surat Areas, the administration of the Cotton Transport Act has broken down. The Indian Central Cotton Committee therefore strongly urges the Government of Bombay to take effective measures to prevent the transport of cotton by road from the north of the Tapti to the south.
—B.C.I.R.A.

Indian Cotton Bales: Marking. Indian Central Cotton Committee, *Abstract Proceedings*, 11*th Meeting*, 1925, *Appendix* 1, pp. 45-58.

Rules for marking bales are given with examples of the method to be employed. Local Governments are also required to publish weekly statements of the amount of cotton pressed in their areas, and the necessary forms for returns are illustrated.
—B.C.I.R.A.

10—MISCELLANEOUS

Oils and Fats: Application. — Flemming. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 163-167.

Notes on the properties and applications of the common oils, fats, and soaps used in the textile industry. The main test applied to these substances are described.
—B.C.I.R.A.

Tetrapol: Composition. Chemische Fabr. Stockhausen and Cie. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 477.

Since 1921 perchlorethylene has replaced carbon tetrachloride in the manufacture of Tetrapol on account of its greater resistance to the action of iron (in transport and use) and because of its higher boiling point, which allows of Tetrapol being used hot. A rumour that Tetrapol is injurious to the health of its users is strongly refuted.
—B.C.I.R.A.

Paper Pulp: Action of Acids, &c. R. Sieber. *Papier-Fabr.* (Verein Zellstoff Ing.), 1925, **23**, 765-767.

The effects of chemicals on the strength and milling properties of cellulose are discussed. Data and curves are given dealing with the breaking lengths and milling numbers (Schopper-Riegler). Sulphuric acid (1%) in three hours at 50° weakened a Swedish sulphate pulp by about 13%, but did not alter its milling properties. Lactic acid (2%) in 48 hours at 30° did not appreciably affect a sulphite pulp, neither did 5% sodium hydroxide in 24 hours. Boiling with lime water for two hours, however, effected a considerable drop in strength and milling properties, but a subsequent treatment with N/10 sulphuric acid at 25° improved the pulp to a slight extent. Milling in 10% sodium sulphate is scarcely different from milling in water. Prolonged drying of a sulphate cellulose had the effect of decreasing the rate of milling, as though the pulp had become "horny." —B.C.I.R.A.

Cellulose: Isolation. P. Krais. *Papier-Fabrikant* (Verein Zellstoff Ing.), 1925, **23**, 797-799.

In connection with the utilisation of Argentine reeds for the manufacture of paper, a process of digestion by nitric acid (or sodium nitrate and sulphuric acid) has been devised. Preliminary work is described, but final details are not yet available. An excellent product is obtained and straw digested by this process gives a longer fibre and a considerably paler Methylene Blue colour than straw treated by the sulphate process. Reeds, straw, bark, chips, sugar cane, bamboo, banana, agave, beech, poplar, &c., can be treated in the same apparatus. The process can be very cheaply applied in South America where the better sorts of caliche and crude minerals can be used. Electrically prepared nitric acid should be employed in Europe. —B.C.I.R.A.

Electrical Dust Deposition Plant. E. Zopf. *Papier-Fabr.* (Verein Zellstoff Ing.), 1926, **24**, 38-43.

The Cottrell-Möller and Lurgi electrical dust precipitation systems are described and their application to the wood cellulose industry for recovering sulphur from exhaust furnace gases is discussed.
—B.C.I.R.A.

Flowmeter; A New Type of——. J. H. Powell. *J. Scientific Instr.*, 1926, **3**, 144-148.

A form of flowmeter is described in which a loosely fitting piston of neutral buoyancy is impelled along a glass tube by the flow of the liquid, against a spring control in which the restoring force is proportional to the square of the displacement, so as to obtain an approximately even velocity scale. The movements of the piston are recorded on a photographic drum nearly touching the tube, by filling a groove in the piston with radium luminous compound.
—L.I.R.A.

Outflow of Liquids; A Method for the Quantitative Measurement of Quick Changes in the——. G. V. Anrep and A. C. Downing. *J. Scientific Instr.*, 1926, **3**, 221-224.

The method involves the variation of electrical resistance of a hot wire due to changing rates of flow of air past it. The liquid flows into a vessel having an air outlet in which a fine platinum wire is fixed. This is heated by a battery and changes in the rate of efflux of air produce changes in temperature and resistance of

the wire. These are recorded by a galvanometer. The fine wire has low heat capacity and when used with a galvanometer of short period will record rapid changes of rate of flow of liquid. The deflection is proportional to the velocity of the air over a wide range. Beyond this the instrument is used by means of a calibration curve. —L.I.R.A.

Thermostat; Note on the Prevention of Flickering, in the Flames of a Gas-controlled——. A. Griffiths. *J. Scientific Instr.*, 1926, **3**, 230.

The usual single tube, the opening of which is controlled by the height of the mercury, causes serious flickering when nearly closed. This is replaced by a bundle of fine tubes, the lower end being ground obliquely. This gives better control and completely stops flickering. —L.I.R.A.

Vibrating Machinery: Damping. —. Gerb. *Physikal. Ber.*, 1925, **6**, 1665 (from *Maschinenbau*, 1925, **4**, 53-54).

An arrangement is described for absorbing energy of oscillation and consists in a combination of spiral springs with elastic materials of high internal damping. The damping device is mounted on a slab of concrete. —B.C.I.R.A.

Oscillation Recorders. J. Geiger. *Physikal. Ber.*, 1925, **6**, 1665 (from *Proc. Intern. Congr. Applied Mech. Delft.*, 1924, 359-362).

Three new instruments for recording oscillations in mechanical structures are described. The Torsiograph registers vibrations in stationary machinery or in ships and also in rotating shafts. It consists of a very light disc which follows the motion of the structure under investigation and a heavy rotating fly-wheel. The two are joined by springs. The relative motion of the two discs is transmitted by a lever mechanism to a recording device. The Vibrograph registers vibratory motion in an analogous way. It may be adjusted to measure vibrations in any one desired direction. The Vibrograph is useful for registering vibration of machinery, buildings, streets, &c., and permits the characteristic frequencies to be ascertained. The Universal Registration apparatus is generally applicable; it is convenient for determining the bending oscillations of steam turbine shafts and of bridges under railway trains in motion. —B.C.I.R.A

Balance: A Modification of the Deflection for Use in Biochemical Laboratories. J. W. Trevan. *Biochemical J.*, 1926, **20**, 419-422.

A simple form of balance is described, the action of which depends on the bending of a steel wire. The amount of bending is determined by the movement of a mirror carried by a micrometer screw. Weights between 1 mg. and 30 mg. can be found, correct to $\pm 0{\cdot}01$ mg. in 30 seconds and by using a series of balance wires of different thicknesses the range of weighings may be increased to 1 gram. —L.I.R.A.

Mule Spinners' Cancer: Control. A. Leitch. *Text. Merc.*, 1926, **74**, 211.

Mule spinners' cancer chiefly affects the scrotum, but other parts of the skin are also liable. A practical means of control is by constant medical inspection—every three or four months—so that the carcinoma is detected in the earliest possible stage and cancer prevented. Other possible means of control include the development of an oil which does not produce the disease and which could be used in the machinery, and wearing impervious clothing, but this the spinners are said to refuse to do. —B.C.I.R.A.

***Diplodia gossypina*: Life History.** N. E. Stevens. *Rev. Appld. Mycology*, 1926, **5**, 90 (from *Mycologia*, 1925, **17**, 191-201).

Further study of the species of *Botryosphæria* and *Physalospora* has shown that the perfect stage of *Diplodia gossypina*, the cause of a boll rot of cotton, is a *Physalospora* closely related to *P. malorum* (*P. cydoniæ*). It is provisionally named *P. gossypina* and is distinguished from *P. cydoniæ* by its slightly larger perithecia and ascopores. The pycnidial stage cannot be distinguished from *D. natalensis* on morphological grounds, but the latter is able to grow at higher temperatures. The *Botryosphæria* on cotton tentatively referred to *B. fuliginosa* by Edgerton (*Mycologia*, 1912, **4**, 34) is considered to be identical with *B. ribis*. The name *B. fuliginosa*, as used by Ellis and Everhart, includes species of both *Botryosphæria* and *Physalospora* and was apparently never valid for any of these fungi. There is stated to be as yet no evidence that the species of *Diplodia* common in the south-eastern United States are limited to certain hosts, but rather that they pass readily from one host to another. —B.C.I.R.A.

Celluloid: Manufacture. K. Atsuki. *Brit. Chem. Abstr.*, 1926, **1**, B46 (from *Cellulosie Ind., Tokyo*, 1925, **1**, 3-13).

Normal cotton cellulose, well purified, is the only acceptable raw material for celluloid; it may be in the form of cotton wool or tissue paper. Other celluloses, such as those from wood, straw, or bast fibres, either contain too much non-resistant cellulose or are chemically modified by the process of digestion. Old cotton rags are unsuitable for the manufacture of tissue papers for celluloid. Loose cotton wool prepared from spinning wastes gives nitrocellulose of the highest viscosity, but unless the solvent and mechanical means for dispersion are exceptionally well adapted the celluloid is apt to be brittle. Tissue paper made from sound cotton

material has the advantage over cotton wool of greater cleanliness and the properties of the celluloid may be controlled to a great extent by treatment of the pulp. Wet beating lowers the viscosity of the nitrocellulose and gives a celluloid which is soft and plastic. The correct beating should be sharp and free, to afford uniform nitration, with a slight amount of developed hydration according to the plasticity desired. Thick papers are not uniformly nitrated; the best thickness is between 0·04 and 0·07 mm. The structure of the sheet should be as open as possible provided it is uniform. The ratio of substance in grms. per sq. metre to thickness in mms. should be less than 600. The chemical purification must be carefully controlled. The use of coloured rags for a bleached paper is condemned. Colour due to traces of iron is not very harmful as it is removed by acids. Colour due to organic matters must be eliminated by careful bleaching. A standard colour for celluloid tissue paper may be taken as 0·05 by the Lovibond tintometer.
—B.C.I.R.A.

Mercuric Chloride Wood Disinfectants: Application. R. Falck and S. Michael. *Z. angew. Chem.*, 1926, **39**, 186-193.

A contribution to the knowledge of mercuric chloride as an agent for impregnating wood, seeds, &c., with a discussion, based on the authors' observations, as to the exact way in which the compound is taken up by the fibre. The conclusion is that mercuric chloride used as a disinfectant, seed protector, or impregnating material is adsorbed on the tissue and is not in chemical combination with the fibre. —B.C.I.R.A.

Photomicrographs: Application. F. Pichler. *Melliand's Textilberichte*, 1926, **7**, 79-80, 157-163.

The application of photomicrography in the elucidation of textile problems is discussed. The article deals chiefly with wool, but an instance of a sieve-like effect in dyed artificial silk stockings is described in which the damage was shown not to occur in the dyeing process, but to be already present in the undyed fabric and to be due to differences in the internal structure of the artificial silk. —B.C.I.R.A.

Ribbon Loom: Historical. F. M. Feldhaus. *Melliand's Textilberichte*, 1926, **7**, 95-96.

It is usually assumed that the ribbon loom was a Danzig invention of the end of the 16th century, but historical evidence is provided which seems to indicate that it first appeared in Leiden in 1621.
—B.C.I.R.A.

Spinning Wheel: Historical. F. M. Feldhaus. *Melliand's Textilberichte*, 1926, **7**, 93-94.

Some historical notes on the spinning wheel in Germany. —B.C.I.R.A.

Colour Experiments with Wensleydale Sheep: The Control of Black. F. W. Dry. *Wool Record*, 1926, **29**, 948.

The experience of a large number of Wensleydale sheep breeders has been collected during the last few years, with a view to a practical application for the elimination of blacks. From the experiments done it is calculated that something like 40% of all-white lambs born are incapable of becoming parents of blacks. During 1925 experiments have been undertaken to eventually establish a flock consisting entirely of animals unable to have black lambs. All animals chosen are a little pale in colour inside the ears and are from ewes which never had a black, even by rams known to be able to sire blacks. The offspring is divided between old rams with all-white records. The proposed plan in autumn 1926 is to mate the all-white ram lamb with blacks, and a ram siring eight lambs all white from black ewes, is certain never to give anything but whites. Trial mating would then become unnecessary and the flocks would come to consist entirely of animals that would not produce black lambs with any Wensleydale mate whatever.
B.R.A.W. & W.I.

Pink Bollworm in Mexico; Biology of——. P. I. Garcia. *Rev. Appld. Entomol.*, 1926, **14**, Ser. A, 83 (from *Bol. Direccion Estudios biologicos*, 1925, **3**, 1-11).

The paper contains data collected by the author who was appointed in 1920 by the Mexican Government to study the biology of the pink bollworm in Mexico.
—B.C.I.R.A.

Photometry. A. Kohlrausch. *Physikal. Ber.*, 1925, **6**, 153 (from *D. Opt. Wochenschr.*, 1924, **10**, 59-64).

The article relates to methods of measuring the relative brightness of dissimilar colours and their application in photometric and colorimetric practice. It is shown that photometric comparison difficulties with different coloured lights are due less to uncertain standardisation than to phenomena of a physiological-optical nature. For persons with normal colour vision there are, in addition to the twilight value, two daylight values. The lower of these is given by colour extinguishing methods and by all methods depending on a temporary ability to distinguish colour differences in lights. Brightness values of lights are additive in light mixtures and are important in considering the efficiency of light sources for workrooms, &c. The higher values are obtained by the foveal beam method and, where the colour differences are large, by direct comparison. This value is important for the visibility of small coloured points such as signal lights. These latter values are not additive in mixtures. —B.C.I.R.A.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Coat of the Lapland Wolf. J. C. Ewart. *Nature*, 1926, **117**, 914 (from *Proc. Roy. Soc. Edinburgh*, 1926, June).

The coat of some mammals consists of simple fibres with solid cortex and cuticle, as in wool fibres; others have pith forming a discontinuous medulla, as in furs, and these are true hair fibres. In the Lapland wolf the long coarse fibres which form the outer coat have the structure of true hair. The short fine fibres of the inner coat are typical fur fibres. Instead of the fibres of a bundle occupying one pit or follicle, the root of each fibre is lodged in a separate follicle. In some dogs there are in addition to wool fibres and fur fibres, numerous fibres, the inner half of which has the structure of wool and the outer of true hair. Sometimes the inner third resembles wool, the middle third fur, and the outer third true hair. —B.R.A.W. & W.I.

(C)—Vegetable

Cotton Pests in Barbados. C. C. Skeete. *Rev. Appld. Entomol.*, 1926, **14**, Ser. A, 47 (from *Rept. Dept. Agric. Barbados*, 1924-1925, 5-6, and 9-10).

Platyedra (*Pectinophora*) *gossypiella* occurs in almost all the cotton growing districts of the Island, and efforts are being made to prevent its further spread by enforcing legislation. *Alabama argillacea* should be controlled by dusting with Paris green. Infestations of *Aphis gossypii* were rapidly reduced by parasites. —B.C.I.R.A.

Cotton Pest in South Africa. *Rev. Appld. Entomol.*, 1926, **14**, Ser. A, 11 (from *J. Dept. Agric., Union S. Africa*, 1925, **11**, 380-381, 384-385).

The larva of a species of *Pyroderces* on cotton, provisionally regarded as *P. simplex*, has given rise to a certain amount of alarm owing to its superficial resemblance to the pink bollworm. It does not, however, appear to be responsible for any primary damage and is regarded as a scavenger. —B.C.I.R.A.

Cotton Cultivation in Peru. *Bull. Imp. Inst.*, 1925, 480 (from *Peru*, 1925, **2**, No. 9, 53 and 93).

Cotton is planted during the period September to November, when rising temperatures coincide with the river flush of water required for irrigation. The alluvial soils brought down from the Corderillas by the rivers make an admirable medium for cotton growing, and the yields are generally phenomenal. *Gossypium hirsutum* in the Zara valley yields an average crop of 1,297 lb. per hectare. The yields in the valleys of the Chancay Huacho, Lima, Lurin, and Mala fluctuate between 900 lb. and 2,076 lb. per hectare. The valley of the Chincha and the high parts of the valley of the Ica average 1,211 lb. and 1,405 lb. respectively. Sea Island in the valley of Pativilca gives an average yield of 970 to 1,107 lb. per hectare and in the valley of the Chira Mitafifi averages 1,384 lb. The perennial indigenous cotton (*G. peruvianium*) is grown on the largest scale in the valleys of Piura, Sechura, Catacaos, and Chira. It averages only 392 lb. per hectare in the first year, but this is increased to 588 lb. in later years. Piura cotton is known as "full rough." The same variety grown in the valleys of Ica and Palpa produces "moderately rough Peruvian" at an average yield of 908 lb. per hectare. A brief reference to Tanguis and the production and export figures up to 1923 are given. —B.C.I.R.A.

Seed Injury from Fungi and Insects. L. C. Doyer. *Internat. Rev. Sci. and Pract. Agric.*, 1926, **4**, 150-154.

The author outlines the methods in use at the seed testing station, Wageningen, to investigate the injury caused by fungi and insects to various kinds of seeds. *Colletotrichum linicolum* and *Botrytis sp.* were present on flax seed and it was found that treatment with Upsulun dry disinfectant or with Germisan proved very effective in the control of *Botrytis* infection. These dry disinfectants are especially valuable for use with flax seed for which solutions with few exceptions are unsuitable. —L.I.R.A.

Investigation in regard to Weed Seeds found among the Seeds of Argentina, with reference to their Origin and Distribution in the Producing Districts of Argentina. W. V. Petery. *Inter. Rev. Sci. and Practice of Agric.*, 1925, **3**, 1163-1171.

In an investigation of the seeds of various Argentina crops with a view to determining their place of origin from the particular weed seeds found in them. it was found that the weed seeds found in flax samples were of somewhat the same nature from all districts, so that the place of origin of flax seed could not be determined by this method. A fairly lengthy list of the weed seeds found in flax seed samples is given. —L.I.R.A.

Hypertrophied Lenticels on the Roots of Cotton Plants. J. Templeton. *Ministry of Agriculture, Egypt. Tech. and Sci. Service*, 1926, Bulletin 59, pp. 7.

In cotton plants growing in excessively moist soils, the lenticels on the upper

portions of the root become hypertrophied into large white protuberances. A series of experiments were made with plots which were irrigated with equal quantities of water every one, two, three, and four weeks respectively. The increase in the amount of water supplied was reflected in an increase in the number and size of the lenticels. It is suggested that the presence of hypertrophied lenticels might serve as a method of ascertaining when to decrease the amount of water given in irrigation. This would lead to the saving of water at a time, before the arrival of the flood, when water is tending to become scarce. By growing cotton plants in soil covered by a layer of water it was shown that while hypertrophied lenticels developed even if the water were aerated, the degree of hypertrophy could be increased by reducing the supply of oxygen to the roots.

—R.W.M.

Pectin of Sugar Beet; Composition of——. F. Ehrlich and R. v. Somerfeld. *Chem. Zentralblatt*, 1926, **1**, 2367 (from *Biochem. Zeits.*, **168**, 262-323).

Pectin is extracted from sugar beet by heating with water under 1 to 2 atmospheres excess pressure. The "hydropectin" so obtained consists of 25-35% araban and 65-75% calcium-magnesium pectate. Treatment of hydropectin with hydrochloric acid gives a mixture of two isomeric digalacturonic acids, $C_{10}H_{14}O_8(COOH)_2$, both of which on acid hydrolysis yield crystalline *d*-galacturonic acid. Ehrlich's former conception of galactose-galaturonic acid as a constitutent of pectin is now discarded. The araban consists almost entirely of 1-arabinose residues, as shown by hydrolysis with dilute acids. Pectic acid is described, and is said to contain acetyl groups easily split off by acid, alkali, or hot water. From the analytical results the formula $C_{43}H_{62}O_{37}$ is assigned to pectic acid, complete hydrolysis giving four molecules of galacturonic acid, two of methyl alcohol, three of acetic acid, one of arabinose, and one of galactose.

—L.I.R.A.

Sea Island Cotton Flower: Colour Inheritance. L. S. Burd. *Trop. Agric.*, 1926, **3**, 56-57.

In the 1923 season three plants with white flowers were noticed in a plot of golden yellow flowered pure strain A.N. Sea Island cotton. The F_1 plants raised from the white and yellow seed consisted entirely of plants with pale yellow petals; F_2 produced approximately yellow: intermediate: white in the ratio 1:2:1, but three if not four shades of yellow were observed. The conclusion is tentatively drawn that the fundamental difference between the white and yellow flowered plants is due to a single pair of Mendelian allelomorphs, and that there is also at least one modifying factor which may control the depth of yellow pigment in coloured individuals. —B.C.I.R.A.

Cotton Pests in Ceylon. J. C. Hutson. *Rev. Appld. Entomol.*, 1926, **14**, Ser. A, 39 (from *Ceylon Administ. Repts., Dept. Agric.*, 1924, D15-16).

Cotton pests reported in the Island are the pink bollworm, *Platyedra gossypiella*, which is becoming prevalent in the Southern Province, *Cosmophila indica*, *Earias* spp., *Sylepta derogata*, *Eupterote geminata*, *Stauropus alternus*, which was recorded for the first time on cotton in Ceylon, and *Dysdercus cingulatus*. —B.C.I.R.A.

Cotton Cultivation in the Sudan. R. A. Wardle. *Text. Merc.*, 1926, **74**, 150.

The Southern Sudan is not an ideal area for rain-grown cotton owing to the shortness of the rainy season and the uncertain distribution of the annual rainfall, but indigenous short staple cottons have been grown for at least 80 years. Experiments have shown that American long staple varieties could be successfully grown and would produce cotton sufficient in quantity and quality to justify the establishment of cultivation in the Central and Southern provinces. It is doubtful whether Egyptian cotton could be grown as a rain crop on a commercial scale. The Government policy for encouraging and improving cultivation is outlined. The present low yield per acre is attributed to the primitive agricultural methods in use. The problem of transport is acute, particularly in the south. The quality and quantity of the labour available in the centre provinces is fairly good, but in the southern provinces labour is unsatisfactory. This year about 15,000 bales of rain cotton should be produced in the Sudan. —B.C.I.R.A.

Tellapathi and Cambodia Cotton Cultivation in India (Vizagapatam). *Empire Cotton Growing Review*, 1926, **3**, 57 (from *Digest of Operations of the Dept. Agric., Madras*, June 1925).

Tellapathi cotton (*G. herbaceum*) is sown only on small areas and is not of much commercial importance. It is generally sown on the drier soils as a mixed crop with either red gram or gingelly. Experiments with Cambodia cotton for many years have averaged poorly, though as much as 1,200 lb. kapas per acre has been harvested. The variety has proved to be very adversely affected by abnormal seasonal variations, and an excess of soil water produces a check in growth from which it does not readily recover. —B.C.I.R.A.

Cotton Cultivation in S. Rhodesia. C. L. Robertson. *Empire Cotton Growing Review*, 1926, **3**, 59 (from *Rhodesian Agric. J.*, 1925, **22**, 745).

The climatic conditions differ greatly from those in the cotton belt of N. America, and a map is given showing roughly the distribution of the conditions, the shaded part being that which apparently will suit cotton without irrigation. —B.C.I.R.A.

Flax Sickness of Soil; Investigations on the Biological Causes of the——. A. N. Kletschetow, *Rev. App. Mycology*, 1925, **5**, 100 (from *J. Landw. Wissenschaft, Moscow*, 1924, **1**, No. 7-8, pp. 511-521, through *Z. f. Pflanzenkr.*, **53**, No. 5-6, pp. 208-209).

The author investigated the causes of "flax sickness" of the soil at the Agricultural Academy of Moscow (Petrovsko-Razoumovskoye), where flax was cultivated on some plots for nine consecutive years, at the end of which the crop completely refused to grow. As the soil was copiously manured with mineral and organic fertilisers, and other plants, e.g., *Capsella bursa-pastoris* and *Thlaspi arvense*, developed vigorously on it, there could be no question of exhaustion of the soil, nor of the accumulation in the soil of toxic substances secreted by the flax. On the other hand, the presence of the following parasitic fungi was determined—*Asterocystis radicis, Thielavia basicola, Colletotrichum lini, Fusarium lini, Macrosporium sp., Alternaria sp., Cladosporium herbarum*, a species closely related to *Phoma exigua* Desmaz (on the roots of flax), and *Pythium de Baryanum*. The author comes to the conclusion that the trouble is due not to any one of these fungi alone, but to the combined action of the whole series.
—L.I.R.A.

Cotton Cultivation in the Union of S. Africa. General Kemp. *Empire Cotton Growing Review*, 1926, **3**, 81-86.

The Minister of Agriculture reviews the present condition of cotton growing in S. Africa. —B.C.I.R.A.

Cotton Cultivation in Malta. *Empire Cotton Growing Review*, 1926, **3**, 170 (from *Report Supt. of Agric., Malta*, 1924-25).

The good winter rainfall has encouraged the farmers to attempt to win a catch crop of cotton. Cotton is also under irrigation on a small scale in the West District. Upland long-staple on the Experiment Farm has done badly for want of rain and owing to the unsuitable soil. Small crops are being cultivated, however, on a commercial scale and proving more productive than the old varieties. The staple is longer, whiter and slightly lighter in weight. Calabria or Gallipoli cotton shows a resistance to root rot and a staple superiority that has caused its rapid spread over both islands. The production is just about as good, and in the long run should prove remunerative. —B.C.I.R.A.

Cotton Pests Control in Cyprus. *Empire Cotton Growing Review*, 1926, **3**, 58 (from *Ann. Rept. Dept. Agric., Cyprus*, 1924, p. 5).

The cotton bollworms are increasing, and drastic measures have been taken to combat them. A closed season in affected areas is enforced prior to which all plants must be pulled up and burnt.
—B.C.I.R.A.

Cotton Pests on the Gold Coast. G. S. Cotterell. *Rev. Appld. Entomol.*, 1926, **14**, Ser. A, 9 (from *Gold Coast Rept. Agric. Dept.*, 1924-1925, pp. 34-36).

The following are recorded as attacking cotton in the Mandated Territory of British Togoland—*Sylepta* sp. (cotton leaf roller), which is a minor pest and is heavily parasitised; *Aphis gossypii*, which becomes a serious pest during the dry weather but disappears with the rains; *Earias* spp., common early in the season; *Helopeltis*, only a pest at the beginning of the season and disappearing entirely at the end of the rains; *Dysdercus* spp., which are pests of major importance accounting for 40-50% of the potential yield in some parts; and *Oxycarenus* sp., which does not cause staining but possibly affects the vitality of the seed. —B.C.I.R.A.

Pink Bollworm: Control. L. Trabut. *Rev. Appld. Entomol.*, 1926, **14**, Series A, 118 (from *Bull. Agric. Alg.-Tun.-Maroc.*, 1926, **32**, 1-2).

It is pointed out that the chloropicrin or sulphuric acid treatment of cotton seed, whilst doubtless efficacious against pests attacking the outside of cotton seed, is useless against pink bollworm, which lives within the seed. Heat seems to be the only effective treatment for this pest, and will kill up to 98% of the larvæ, but sufficient still remain to continue the infestation, and the germination of the seed is affected. —B.C.I.R.A.

Cotton Diseases in Porto Rico. M. T. Cook. *Rev. Appld. Mycology*, 1926, **5**, 227 (from *Rev. Agric. Puerto Rico*, 1925, **15**, 300-301).

The diseases which have so far been reported as occurring on cotton in Porto Rico are enumerated. They include leaf spot, areolate mildew, rust, anthracnose, boll rot, and root diseases due to *Fusarium* sp. and *Sclerotium rolfsii*. A brief description is given of the symptoms of each disease. A warning is given of the possibility of the introduction of other diseases from abroad, especially from the Antilles and the United States. —B.C.I.R.A.

Cotton Wilt Disease. N. G. Zaprometoff. *Rev. Appld. Mycology*, 1926, **5**, 175 (from "Diseases of Cultivated Plants in Middle Asia," 165 pp., *Uzbekistan Plant Protection Station, Tashkent* (Russian), 1925).

Cotton seedlings suffer from a wilt attributed to *Nectriella vasinfecta*, the mycelium of which clogs the vascular bundles and interferes with the water supply of the plant. Generally the infected seedlings show a swelling at the base of the stem,

together with an oblong brown canker which in wet weather turns pink. Inside the host tissue the fungus produces hyaline micellular micro-conidia, and on the surface of the dead tissue, 3-5 celled macro-conidia of the *Fusarium* type. Chlamydospores are also occasionally produced. The perithecia of the fungus are found on the roots and underground portions of the stem. —B.C.I.R.A.

Cotton Bollworms in S. Nigeria. A. W. J. Pomeroy. *Fourth Annual Bull. Dept. Agric. Nigeria,* 1925, pp. 89-108.

Details of the life histories and essential descriptions of six different species of bollworms found on the cotton plant in Nigeria. *Argyroploce leucotreta,* Meyr., was found more prevalent on Meko than on Allen cotton. *Diparopsis castanea* Hmpsn., *Earias bilaga* Walk., and *Earias insulana* Boisd. were more numerous on late sown cotton, though they occurred throughout the season. *Prodenia litura* F. in the late season and *Heliothis obsoleta* F. in the late season were also found on both native and exotic varieties. —B.C.I.R.A.

Allen Cotton Cultivation in Nigeria (Kabba Province). H. B. Waters. *Fourth Annual Bull. Dept. Agric. Nigeria,* 1925, pp. 115-119.

Early sown Allen cotton suffered severely from "leaf roll," and native cotton yields were in all cases at least 20% higher. American cotton is therefore not recommended. —B.C.I.R.A.

Ishan Cotton Cultivation in S. Nigeria. C. J. Lewin and T. G. Mason. *Fourth Annual Bull. Dept. Agric., Nigeria,* 1925, pp. 109-114 and 126-127.

In seeking to improve the coarse native production of *S. peruvianum* types, a variety of *G. vitifolium* from the Benin Province in the Palm Belt is under consideration. Single plant selections averaging 33·6 m.m. in staple length, with a ginning outturn of 32%, are being propagated. The peculiar condition of the W. Provinces, where most of the cotton is grown, necessitate probably the growth of a mixture of early and late varieties. In some years pests destroy the early varieties, and in others severe Harmattan damages the late. Great uniformity in character of lint may therefore have to be sacrificed. Ishan is not a pure strain, for a number of plants produced seeds with red lint, which it is hoped to eliminate by selection. —B.C.I.R.A.

Cotton Cultivation in Nigeria (Umuahia). H. Roebuck. *Fourth Annual Bull. Dept. Agric., Nigeria,* 1925, pp. 161, 162, 164, and 165.

Field trials of Ishan and Munshi native varieties against Allen are reported. —B.C.I.R.A.

Cotton Cultivation in Nigeria (Ilorin). T. Thornton. *Fourth Annual Bull. Dept. Agric., Nigeria,* 1925, pp. 171-175, 180, and 182.

Field trials and rotations with Allen and native cottons are reported, with notes on pest attacks. —B.C.I.R.A.

Allen Cotton Cultivation in N. Nigeria (Zaria). *Fourth Annual Bull. Dept. Agric., Nigeria,* 1925, pp. 192-217.

The total rainfall for the season lasting from April to October was 46·32 in. at Zaria, with July, August, and September exceeding 10 in. Though the yield per acre was adversely affected by an attack of cotton leaf roll, the average for the farm was practically double the yield for the previous year. Bollworm attacks were less, whilst boll shedding was very general. At the Maigana Seed Farm, yields averaging about 290 lb. seed cotton per acre were achieved. About 631 acres of native grown Allen in the district were kept under supervision, and the British Cotton Growing Association purchased the crop. —B.C.I.R.A.

American Cotton Cultivation in S. Nigeria. T. G. Mason and H. C. Wright. *Fourth Annual Bull. Dept. Agric., Nigeria,* 1925, pp. 3-31.

The 1924-25 experiments revealed no significant differences in the yielding capacities of American and native cotton. The number of open bolls per acre produced by American cotton was in a large measure a function of the specific conductivity of the 1 to 5 soil extract; whilst the hygroscopic coefficient of the subsoil was an additional influence on the number of native cotton open bolls. Great loss of crop was experienced in the late phases of the development of the boll, through bollworm and through internal boll disease, which was more pronounced on American than on native cotton. Anthracnose was second only to bollworm in reducing the native yield. A tendency on the part of native cotton to postpone flowering until the termination of the rains was noted, whereas American set most of its bolls before the rains ceased. A new disease, "leaf roll," was discovered in the course of the work. —B.C.I.R.A.

Cotton Boll Rot Diseases in S. Nigeria: Causes. T. Laycock. *Fourth Annual Bull. Dept. Agric., Nigeria,* 1925, pp. 32-49.

Internal Boll Rot.—The responsible fungus, which has not yet been determined, is probably allied to *Nematospora* and corresponds to Nowell's Type C. Only negative results were found in a search for the fungus on *Dysdercus*; but the evidence clearly indicates that the disease is introduced through seed puncturing, and the stainer is probably a carrier. Infection was completely demonstrated six days after

boll puncturing. No alternative host has been discovered in Nigeria.

Anthracnose (*Glomerella gossypii*).—Before this disease attacks the bolls readily it appears that the host has to experience a setback, due to the sudden advent of severe Harmattan, which is invariably accompanied with very low night temperatures and heavy precipitations. Anthracnose appears to be a facultative parasite attacking only the bolls, which may be completely rotted.

Fusarium Boll Rot.—Fusarium occurs on the vegetative as well as the reproductive parts of the cotton plant. It is a saprophyte, and damp conditions, together with prior wounding by pests or bacteria, favour its development.

—B.C.I.R.A.

Cotton Cultivation in Nigeria (Moor Plantation, Ibadan). *Fourth Annual Bull. Dept. Agric., Nigeria*, 1925, pp. 122-159.

Although particularly dry, 1924-25 was reported a good season for cotton. September and October rainfall was below normal, rains ended early, and an exceptionally severe Harmattan was experienced. Best results were achieved with 15th July sowings. Allen is several weeks earlier than native cotton, and whilst Allen produces a large proportion of first and second grade, there is little native cotton in the first grade and a good deal is third grade. Ishan cotton yielded well but was found very variable. A small plot of Meade cotton yielded 224 lb. seed cotton per acre. In seasons like that of 1924-25 the experimental plots of Allen yield equally well with native; and as there was a tendency to discard Allen at the beginning of the season this result is interesting. It still remains to be seen whether Allen will do as well as native in a really bad season, the last two seasons having been exceptionally favourable. Cotton and maize grown together yielded a half crop of maize and almost a full crop of cotton, as compared with pure plots of both. It would appear that the maize did not suffer from competition with the cotton; and for some reason the cotton benefited from the presence of the maize. Rainfall for the year was 44·39 in., as compared with a fifteen years' average of 50·15 in.

—B.C.I.R.A.

Cotton Bollworm and Stainer in S. Nigeria: Control. A. W. T. Pomeroy and O. B. Lean. *Fourth Annual Bull. Dept. Agric., Nigeria*, 1925, pp. 50-63.

The Moor Plantation is the centre of a nine square miles zone in which all cotton had been uprooted three months before sowing the new crop, and all silk cotton trees, *Eriodendron* and *Bombax* spp., had been destroyed. Comparing this closed area with Forest and Savannah areas for intensity of pest attack, no marked decrease in stainer attack was apparent; but the control measures appeared efficacious in diminishing bollworm attack.

—B.C.I.R.A.

Cotton Stainers in Nigeria: Infestation. F. D. Golding. *Fourth Annual Bull. Dept. Agric., Nigeria*, 1925, pp. 64-81.

Near Zaria in N. Nigeria, probably as a result of excessive aridity, stainer bugs were almost completely absent from cotton. At Ibadan the main migration of *Dysdercus* was induced in response to the attraction exerted by heavy flowering. The August influx was of *D. superstitiosus*, and a second infestation of another form of that species and also of *D. melanoderes* occurred in the second week in October. Date of planting experiments of exotic varieties in contiguous plots were found inadvisable owing to the spread of the pest from the earlier plots and the heavier infestation of the late plots. Allen cotton was more subject to infestation than either of the indigenous varieties Meko and Ishan; whilst Meko interposed between Allen plots suffered more than Meko grown alone, owing to the diffusion of the pest from Allen as this variety grows less attractive. Parasitism on *Dysdercus* diminished with increasing dryness and cessation of rains, as did the number of *Dysdercus* bugs themselves. —B.C.I.R.A.

Insect Cotton Pests in S. Nigeria; Occurrence of——. F. D. Golding. *Fourth Annual Bull. Dept. Agric., Nigeria*, 1925, pp. 82-88.

The rhizophagous larvæ of *Syagrus calcaratus* F. were responsible for the death of a considerable number of May and June sown Allen plants at the Moor Plantation, Ibadan; but cotton sown in July was comparatively immune. Native plants when attacked show a greater power of recuperation. Moist soil conditions are required by the larvæ; and it is probably the amount of July and August rainfall that determines the prevalence of the pest.

Helopeltis bergrothi, Reut., attacks the stem, leaves, bolls and buds of the cotton plant and causes greater damage to the native than to exotic varieties. *G. vitifolium* suffered more than *G. peruvianum*.

—B.C.I.R.A.

Cotton Production in South Africa. P. Koch. *South African Cotton Growers' J.*, 1925, **2**, No. 4, pp. 39 and 53.

Figures are given for (1) the annual production of lint in the Union, 1910-11 to 1924-25; (2) the Transvaal, Natal and Zululand, the Cape and Swaziland production in 1922-23 and 1923-24; (3) the areas planted in each of these provinces 1924-25; and (4) the potential areas in these provinces. There are also data as to the number of ginneries and their location and organisations and officers engaged in the industry.

The first estimate of the Union crop was 30,000 bales. This was reduced to 15,000 bales in the third estimate. Of the total loss 10% was ascribed to "washaways," 30% to the shedding occasioned by unfavourable weather, and 60% to insect damage. —B.C.I.R.A.

Cotton Cultivation in S. Africa. *South African Cotton Growers' J.*, 1926, **2**, No. 7, p. 11 (from *Dept. Agric. Rept., Union of S. Africa*).

The 1923-24 crop exceeded that of the previous season by 33·8%, and amounted to practically 7,000 bales of 500 lb. Owing to drought and locusts the Western Transvaal crop was almost a failure. In spite of heavy loss from floods, washaways, and insect attack, the 1924-25 crop will be more than double the 1923-24 crop; and large stretches of land are being cleaned and prepared for the 1925-26 crop. The only serious obstacle is the alarming increase in pests, particularly the bollworm.
—B.C.I.R.A.

(D)—Artificial

Cellulose: Hydration. J. Strachan. *Paper Maker*, 1925, **70**, 615-620.

A condensed report of a paper which claims to give a complete physical conception of the phenomena known as "hydration" in the processes of paper making. The subject is discussed under the headings cellulose as a colloid, structure of the cellulose fibre, "wetness" and hydration, pressure phenomena, physical explanation of beating, theory of felting and measurement of the degree of hydration.
—B.C.I.R.A.

Artificial Silk Developments. *Chemical Age*, 1926, **14**, 297.

The Australian Government is preparing to assist development of rayon production from the lighter eucalyptus plant, which experiments have shown is a suitable source, needing only slight modification of machinery. The Snia Company of Italy is financing a factory in Moscow, and is negotiating for an English factory, possibly in Liverpool, which will employ 2,000 people and turn out 5,000 lb. of rayon a day. The Western Viscose Silk Mills of Bristol expect to be manufacturing this year. From America comes news that cotton yarn or fabric can now be dipped in a solution and converted to rayon.
—F.G.P.

Developments at Strassbourg. *Chemical Age*, 1926, **14**, 42 (Supt.).

A large factory has been recently opened occupying 15 hectares, and three further blocks are in progress. Strassbourg will shortly approach in size the enormous works of Courtauld's, in America and England, and those being erected at Calais. Everything in the way of installation, plant and transport is on the most up-to-date lines, and ensures economy in time and labour. The enterprise is largely due to the efforts of Dr. Bronnert, of Strassbourg. —F.G.P.

Sulphite Pulp and Its Uses. H. Hibbert. *Dyer and Calico Printer*, 1926, **56**, 29.

A chart showing the derivation of various classes of artificial silk and paper from wood. —A.J.H.

Patents

Fine Viscose Filaments: Preparation. W. Mendel. U.S.P. 1,580,844. (from *Silk J.*, 1926, **3**, No. 25, 781).

The invention relates to a means of producing viscose silk filaments without including therein free sulphur or its derivatives, and so avoiding the pit formation normally occurring in cellulose hydrate filaments and due to sulphur elimination. In this way the filament is sufficiently strengthened to be spun as fine as natural silk. The process consists in subjecting viscose to the action of PO_4 ions, preferably by the addition of a solution of tri-sodium phosphate to the coagulating bath. The apparent effect is to prevent the formation of sulphur or its derivatives in insoluble form. The PO_4 ions accelerate the ageing process, and this must be borne in mind if phosphate is introduced at a stage earlier than the coagulation stage.
—B.C.I.R.A.

Fellmongering Preliminary to Tanning. F. Ullman, Assee. of H. Beufey. E.P. 246,114.

Hides and skins are depilated by immersing them in solutions containing lime and less than 1% of sodium hydrosulphide.
—B.R.A.W. & W.I.

Cellulose Thiourethanes: Preparation. L. Lilienfeld, Zeltgasse, Vienna. E.P. 248,246.

The process for making cellulose thiourethanes described in Specification 231,801 is modified by using as the starting material any cellulose derivatives containing the group CSS, other than cellulose xanthofatty acid &c. Suitable starting materials are cellulose xanthic acid or xanthates, or the products obtained by treating these with oxidising agents, or the products of the reaction between the esters of chlorocarbonic acid and cellulose xanthic acids or xanthates, or the esters of cellulose xanthic acids &c. The process is varied only as regards the initial cellulose derivatives from the process of the parent specification. A number of examples are given.
—B.C.I.R.A.

Artificial Silk Dry Spinning Apparatus. Soc. pour la Fabrication de la Soie Rhodiaseta, Paris. E.P.248,696.

For the purpose of controlling the cross-section of the filaments in the manufacture

of artificial silk by the dry-spinning method, heat is provided so as to maintain at the spinning dies and in their immediate neighbourhood a temperature determined by the desired cross-section. The temperature is independent of that obtaining in the body of the individual spinning cell, and is adjusted according to such conditions as the nature of the cellulose derivative and of the volatile solvent, the proportion of the volatile solvent, the viscosity of the solution, the pressure employed at the dies, the diameter of the dies and the final diameter of the filaments, and the rate of flow in the cells of the evaporative medium. The invention is particularly directed to the production of filaments not showing a scintillating effect, such threads being produced by adjusting the temperature within a narrow range. —B.C.I.R.A.

Artificial Silk Solution Circulating Pump. Werdohler Pumpenfabrik P. Hillebrand, Werdohl, Westphalia, Germany. E.P. 248,715.

To obtain a circulation or renewal of the liquid in the air vessels associated with the pumps of an artificial silk spinning plant so as to avoid coagulation of the spinning solution in the vessel, the solution is supplied to the vessel through a pipe which opens at or above the normal level of the liquid, and the liquid escapes through a pipe opening at a lower level, and which may be concentric with the first-mentioned pipe. The air vessel may be mounted directly on the pump-casing or on a union-piece interposed between the pump and the spinning nozzle. —B.C.I.R.A.

Viscose Precipitating Baths: Composition. British Enka Artificial Silk Co., Austin Friars, London. E.P.248,750.

In the manufacture of filaments, ribbons, straws, &c., from viscose, there is added to the acid precipitating bath a salt of a bivalent metal, other than zinc, the sulphide of which is not precipitated in the presence of an acid. Nickel and cobalt sulphates are instanced as suitable salts, and a precipitating bath, described by way of an example, contains sulphuric acid, sodium, magnesium and nickel sulphates. A zinc salt may be added to the precipitating bath provided it contains another metal salt as above. Using precipitating baths containing these additions, the dyeing properties of the products are improved both as regards affinity and evenness. —B.C.I.R.A.

Cellulose Thiourethanes: Preparation. L. Lilienfeld, Zeltgasse, Vienna. E.P. 248,994.

The process of the parent specification for the manufacture of articles or materials from alkyl, aryl and aralkyl substituted cellulose thiourethanes such as are prepared by the process described in Specification 231,801, is modified by using as the agent for precipitating or coagulating the thiourethane a strong acid, e.g., 25-65% sulphuric acid, 45-70% phosphoric acid, 20-35% hydrochloric acid, and 70-100% acetic acid. The products after washing and drying show a high lustre and an improved stability both in the wet and dry conditions. The products, immediately after coagulation, are very plastic and may be stretched or bent, the plasticity disappearing when the acid carried by them is diluted or removed as by washing with water. Further, by the use of strong acids threads of finer counts may be obtained. Another precipitating agent such as an acid or neutral salt may be added to the acid bath. The temperature of the bath may vary within wide limit. Some examples are quoted. —B.C.I.R.A.

Artificial Silk: Dry Spinning Apparatus. Vereinigte Glanzstoff-Fabr. A.-G., Elberfeld, Germany. E.P.249,141.

In the dry spinning of artificial threads the filaments are spun into an unheated atmosphere and are heated subsequently to remove the remainder of the solvent. An arrangement is shown in which the filaments are spun downwardly, passed over a guide through the wall of the spinning chamber and into a heating chamber supplied with a winding device and steam pipes. Or the filaments may pass through a heated chamber and be reeled outside. —B.C.I.R.A.

Artificial Silk Spinning Centrifuge. Glänzfaden A.-G., Petersdorf, Riesenbirge, Germany. E.P.249,142.

In electrically-driven centrifuge apparatus for spinning artificial silk the bearing sleeve, which carries the thrust bearing for the spindle and the casing of the stator of the driving motor, is elastically supported in a fixed casing by means of rubber rings. Specifications 235,166 and 236,173 are referred to. —B.C.I.R.A.

Preparation of Cellulose, Cellulose Acetate &c. H. Dreyfus, Waterloo Place, London. E.P.249,173.

A high quality cellulose readily amenable to acetylation or some such esterification, is prepared by a preliminary treatment of cellulose-containing materials, such as wood pulp, with caustic alkali preferably in concentrations of less than 3%, used in the proportion of 10-40 times the weight of the pulp. The second stage of the process is treatment with glacial acetic acid, and preferably comprises boiling for several hours. Acetylation is then carried out according to previously patented processes, viz., E.P.6463/15, 14,101/15, 100,009, 101,555, 207,562. —H.L.R.

Artificial Silk Spinning Frame Winding Mechanism. W. Schulz, West Lichterfelde, Berlin. E.P.249,490.

In winding artificial silk the material is conducted down a guide tube by a jet of liquid, preferably precipitating liquid, so arranged that the liquid is deflected slightly in a direction reverse from that of the rotation of the bobbin, and that the filament contacts with the bobbin at a point whereby the regularity of the winding is not affected by the jet. Either the bobbin or the tube may be reciprocated to lay the filament. —B.C.I.R.A.

Cuprammonium Silk: Spinning. W. Schulz, Lichterfelde-West, Berlin. E.P. 249,845.

To enable an aqueous solution of ammonia to be used as the coagulating bath in the stretch-spinning of cuprammonium cellulose silk, the bath is used at a temperature of 60-95° C., or the travel of the filaments in the bath is increased by employing a minimum distance of 1·5 metres, or by observing both these precautions. In examples, the temperature of the bath which contains 1-2% of ammonia is 80° C., and a spinning length of 2·5 metres is employed. By the use of aqueous ammonia solution as the coagulating medium, it becomes possible to recover the ammonia; it is preferred to employ a bath containing not more than 3-4% of ammonia. —B.C.I.R.A.

Artificial Fibres—

248,468. L. Levy. Artificial Fibres: Pumps and valves.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Cotton Seed: Delinting and Sterilising. C. B. Hardenburg. *South African Cotton Growers' J.*, 1925, **2**, No. 5, pp. 25-27.

The details of the method employed by the African Explosives and Industries, Ltd., in Natal, are given. The seed is placed in a large glazed earthenware basin and 95% sulphuric acid is admitted. After about five minutes' immersion all the lint has disappeared and the mass has turned black. The acid is then run off and a fresh lot of 70% to 75% acid is poured in. After the weaker acid is drawn off, a strong stream of water is played on the seeds. Seven washings are given. Treating one bag of seeds lasts one hour. To complete the sterilisation the washed seed is then dipped for a few minutes in a solution of mercuric chloride, 1 : 1,000. The seed is afterwards spread out in the sun to dry, and bagged in new sacks, so that the risk of contamination by spores on the old sacks is prevented. The advantages are discussed. —B.C.I.R.A.

Application of the Synthetic Esters of Fatty Acids to Textile Fibres. S. Spiess and J. L. Bitter. *Text. Rec.*, 1926, **44**, No. 519, p. 77.

An account of some preliminary experiments in utilising synthetic esters of cheap waste oils such as olive oil, the fatty acids of palm oil, cocoanut and earthnut oils for the working up of shoddy. —A.J.H.

Nasmith Cotton Comber. Dobson and Barlow, Ltd. *Text. Mfr.*, 1926, **52**, 89-90.

An improved Nasmith cotton comber is described in which the most notable improvements concern the roller-weighting motion, double feed rollers, top comb slides, waste-collector roller, exhaust air-filter working in conjunction with Roth's aspirator, and oiling facilities. These improvements, details of which are given, increase the efficiency of the machine and its production and facilitate certain settings and the general control of the machine. —B.C.I.R.A.

(B)—Spinning and Doubling

Spinning Mule: "Breaking Out." F. Metcalfe. *Text. Mfr.*, 1926, **52**, 111-112.

A general article on the systematic "breaking out" of mules, that is, changing the quality of the cotton or changing the hank roving with the same quality of cotton. —B.C.I.R.A.

Antique American Spinning Wheels. S. Daniloff. *Text. Rec.*, 1926, **43**, No. 517, 85-86.

A "chair frame" wheel of about 1750, a wheel designed by Thomas Howland and made prior to 1814, and a wheel patented by Elijah Skinner in 1818 are described. The wheels are of the countershaft type, that is, the motion of the driving wheel is transmitted to the spindle through a countershaft. —B.C.I.R.A.

Bare Spindle Ring Yarn: Spinning. W. Scott-Taggart. *Text. Rec.*, 1926, **43**, No. 517, pp. 47-48.

In the method described a varying frictional effect on the spindle for the winding process is obtained by allowing the spindle to revolve in a liquid bath. It is stated that there is neither evaporation nor leakage, and corrosive effects of the liquid are entirely absent. The yarn spun is equal, and in many cases superior, to that produced on the mule. —B.C.I.R.A.

Flyer Frame Cone Belt: Efficiency. *Text. Rec.*, 1926, **43**, No. 514, pp. 45-46, No. 515, p. 47, No. 516, pp. 43-44.

The following conditions affecting the efficiency of a cone belt are reviewed. Quality of leather and piecing of the belt, thickness, width and tension of the belt, and adjustment of the belt forks. —B.C.I.R.A.

(C)—Subsequent Processes

Electric Singeing Machine. Hussa Machine Works. *Text. Rec.*, 1926, **43**, No. 517, p. 97.

The yarn is singed by means of heat radiated from an incandescent electric conductor. It is claimed that the utilisation of heat is almost complete. The heat of the singeing tube can be regulated by almost imperceptible degrees, and it can be adapted to the count of yarn to be singed and to the winding speed. There is no danger of fire. The method of securing complete suction of the residue of combustion and providing a continuous draught of air favouring combustion is shown in an illustration. —B.C.I.R.A.

Patents

Softening of Flax and Hemp Fibres. C. Dubois. F.P.590,532.

After retting, the fibres are treated with hot lyes; after rinsing, they are washed in soapy water, and after beating and carding, they are softened with an appropriate oil. The yarns are then spun and straightened. —Bur. Text.

Oiling of Spindles in Throstle Frames. Serra Sio. F.P.591,084.

The inferior support of the spindles forms a continuous holder disposed longitudinally and in which rests the end of the spindles. The pivot on which they are supported contains apertures which permit the passage of oil. —Bur. Text.

Feed for Holden Comber. J. Devalée. F.P.592,088.

The ordinary ellipsoidal motion is replaced by a vertical motion of the feed rollers; this is combined with a tangential displacement of the rollers from the comb, and detaches them in an opposite direction to the rotation of the comb. The fibres are thus retained by lateral friction against the needles of the comb. Several pairs of rollers with simultaneous action contribute to feed the comb. —Bur. Text.

New Card Clothing. Etablissements Jos. Deiss. F.P.592,717.

The foundation bearing the bent wires is made with cloth or skin of such thickness and quality that the wires are rigidly maintained. The two halves of the wires, one inside and the other outside the foundation, are in a straight line. —Bur. Text.

Electrical Flyer Frame. H. Schneider. F.P.593,170.

The various flyers are individually driven by electromotors. Yarn guides, forming a grooved gutter between the delivery rollers and the hollow axle, introduce the yarn almost vertically. The bobbins are provided with an autobrake the resistance of which to rotation is reduced by special devices. —Bur. Text.

Rubber-Impregnated Cord: Properties. R. Ditmar, G.P.19,240, 62,246, 117,305, 125,748 and 326,335; and Austrian P. 74,065. (From *Gummi-Ztg.*, 1925, **39**, 1682, through *Chem. Abs.*, 1925, **19**, 2759.)

Cord composed of silk, wool, hemp or other fibre can be improved in strength and in durability by impregnating it with rubber latex. When used for violin strings the appearance of catgut can be imitated and the tone of the instrument is much improved. The cord is first impregnated with rubber by immersing it in latex, which may also contain a little glycerol and a reducing agent such as quinol. When dry it is coated with spermaceti or with hard paraffin, and finally with soap-stone or with a lustre varnish. The process may be modified by adding sulphur to the latex, in which case the cord is vulcanised before the final protective coating is applied. Similarly, cord may be treated with solutions of rubber in organic solvents and vulcanised so that it is suitable for use in racquets, chairs &c. Excellent results are also obtained with "[illegible]lvol" instead of latex. —B.C.I.R.A.

Hard Waste Lubricating Machine. W. Tatham, Ltd., and R. I. Berry, Vulcan Works, Rochdale. E.P.248,179.

Hard fibrous waste as it leaves a breaking-up or opening machine is treated with a soapy liquid on both sides of the fleece by rotary liquid distributing means. The fleece, travelling up a lattice, is treated on its upper side by a brush and a roller dipping into a trough. As the fleece falls from the lattice it is treated on its under side by an auxiliary rotary device comprising a brush and a roller dipping into a second trough. This trough is carried by brackets on the lattice frame, and the brush is mounted in pivoted adjustable arms. A splash guard with side-pieces is provided. Both the troughs may be supplied from a reservoir by a single pipe. —B.C.I.R.A.

Opening Machinery Cleaning Grids. Soc. F. Laroche et Fils, Cours, Rhone, France. E.P.248,333.

The cleaning grids of machines for treating fibres comprise a thin metal plate provided with slits, the metal being beaten out to form protuberances with edges on the inside and hollows on the outside. The openings provide a clear passage for the dirt, &c., along tangential paths, and being long and narrow, oppose the passage of the fibres. —B.C.I.R.A.

Carding Engine. G. C. Laurency, Twickenham, Middlesex. E.P.248,475.

In an arrangement for straightening and parallelising the fibres taken from the doffer of a carding engine the fibres are seized by a leather or similar covered roller, or a roller with a channelled surface, co-operating with a casing comprising a series of flexible blades, held up and pressed

against the roller by springs. The fibres seized and passed forward have their near ends combed by the doffer. At a given point they are combed by a card-covered roller rotating more quickly than the leather-covered roller. This roller is also provided with blades. A further leather covered roller is provided to draw the fibres from the card-covered roller and the drawing operation may be repeated as often as desired. The flexible blades are arranged helically under the rollers. Where ring doffers are employed the blades, which are wider than the rings, are arranged at right angles to the axis of the roller. The card-covered roller may be provided with a brush to remove waste and dirt when necessary. —B.C.I.R.A.

Spindle Reversing Gearing. G. Piering, A., P. and A. Lehmann, Plauen, Vogtland, Germany. E.P.248,697.

The spindles of a spinning or doubling frame are driven through a connection from the spindles of friction rollers which are actuated by friction discs on a shaft, and can be shifted to forward, reverse, or stopping position. —B.C.I.R.A.

Spindle Winding-on Mechanism. O. G. J. Struycken de Roysancour, Delft, Holland. E.P.248,745.

In order that the tension of the yarn as it is winding-on the spindle may be independent of that as it is twisting in spinning and roving frames, the yarn is passed round a braked rotary roller in a driven tube and is wound on a spindle by means of a guide fixed on a bell depending from the tube, by a flyer device of known type, or by an ordinary ring and traveller. The winding-on may be effected by a dragged bobbin arrangement or by a driven spindle, and in the latter case the speed of the spindle is variable in accordance with the winding, or the delivery of the yarn is regulated. The roller may be braked by pads which bear on its ends and are carried in a spring holder by an adjustable ring which bears against a friction ring on the roller, or by a braked ring.

—B.C.I.R.A.

Spindle Driving Mechanism. J. Speak and Tweedales & Smalley (1920), Ltd., Castleton, Manchester. E.P.248,912.

In order to facilitate reversal of a spindle driving apparatus for spinning, doubling, twisting and like machines, tension pulleys and a cylinder or auxiliary pulleys are provided, so arranged that their upper peripheral portions are approximately level with the lower flanges of the spindle whorls. The driving apparatus will then work equally well in either direction. Each tension pulley is mounted on a pivoted weighted arm, so that change in tension due to reversal and variation in length of the driving band can be taken up. —B.C.I.R.A.

Carding Engine. A. Egli, Heidenheim, Wurttemberg. E.P.248,988.

In a cotton carding engine a closed box with a grid on its open top is arranged below the licker-in to produce a sucking action between the licker-in and the grid whereby the good fibres are carried forward and only the dirt and waste allowed to fall through the grid. The box and the grid are adjustable vertically to vary the width of the gap between the licker-in and the grid. A knife is placed to exclude the production of an ejecting air current under the inner edge of the table. —B.C.I.R.A.

Yarn Clearing Device. T. Gibson, Carmoney, Antrim. E.P.249,005.

Yarns are cleared by means of a die of hard material and preferably in the form of a ball, and freely mounted in a slotted tube so that it is supported by the yarn and may rise and fall, and rotate about the yarn, or may have a rotary movement only. The ball is inserted through a gap and its accidental removal during use is prevented by a rubber plug or other spring. The tube is turned about a hinge, when the yarn is arrested by the attempted passage of a slub, so that the ball may fall into a cup and be readily cleared and re-threaded.

—B.C.I.R.A.

Spindle Bearings. Compagnie d'Applications Mécaniques, Ivry, Seine, France. E.P.249,081.

A spinning spindle is mounted in a ball bearing, the inner race ring being fixed to the spindle and the outer race ring being slidable in a housing and under the action of a spring which is calibrated so that the footstep bearing is practically relieved from the load and only serves to position the spindle. The outer race ring may be carried in the step bearing tube or in the outer casing. The bearing tube is held in the casing by a leaf spring. —B.C.I.R.A.

Spindle Driving Mechanism. Soc. Alsacienne de Constructions Mécaniques, Mulhouse, Haut-Rhine, France. E.P. 249,102.

The patent relates to the driving of inclined spindles in continuous spinning and twisting machines by means of tapes, flat bands or belts. In the arrangement shown groups of four spindles are driven by a drum or pulleys so arranged that the driving portion of the belt is perpendicular, or approximately so, to the axis of the spindle, the tension pulley is movable about an axis perpendicular to the portion of the belt which runs therefrom to the spindle, so that the normal inclination of the belt is altered only slightly as the tension pulley moves, and a directive pulley or drum is applied, so that the belt is perpendicular, or approximately so, to the axes of the spindles. An alternative arrangement is shown. —B.C.I.R.A.

Roller Drawing Head. R. Hird, Burley-in-Wharfedale, nr. Leeds. E.P.249,298.

The spring weighting hooks of spinning, doubling and twisting machines are anchored to brackets on a pivoted rail, which is connected by brackets and links to a pin on a worm wheel, so that by operating the wheel the rail may be moved to release the ends of the hooks and thereby relieve the top rollers from the action of the springs. —B.C.I.R.A.

Opener, Conveyor, or Cylinder Lags. J. Young, R. M. Young and W. Young, Bolton, Lancs. E.P.249,337.

Lags for application to the conveyors of hopper bale breakers, hopper feeders, or to the cylinders of openers, &c., are formed of a metal strip with teeth formed integral therewith and projecting in a forward direction. The teeth may be stamped or pressed out of the metal strip, or out of a blank, or may be forged or cast integral with a flat bar. Additional teeth may be formed on the rear edge of the strip, and may be staggered in relation to the teeth. —B.C.I.R.A.

Comber Detaching Roller Weighting Device. J. Hetherington & Sons, Ltd., Ancoats, Manchester, and J. Horridge, Bolton, Lancs. E.P.249,347.

In an arrangement for weighting the detaching rollers of cotton and other combing machines in which the rollers can be relieved from the weights, an arm hooks over the back roller and is attached at its other end to an arm on a rocking shaft. The first-named arm is provided with an inclined slot which may have a depression at its upper end. A hand lever carries a pin which engages the slot and is pivoted at its lower end to the weight lever at a point between the fulcrum and the point of attachment of the weight. The weight lever carries a stop adapted to rest on the framework when the weight is taken off the rollers. If the handle is moved to the right, the weight lever is lifted and the pin rests in the depression of the slot. If the handle is moved to the left, the weight lever is lowered until the stop rests on the framework. Similar weighting arrangements for the middle and front rollers are described. The device may be operated by a treadle. —B.C.I.R.A.

Lap-Forming Apparatus. L. Schorsch, Gorkan, Czecho-Slovakia, and A.-G. J. J. Rieter et Cie, Winterthur, Switzerland. E.P.249,564.

The fleece collected on the cages is passed by an upwardly inclined double lattice band to a second vertical pair of bands which are oscillated across a transversely moving apron or table. The doubled fleece is compressed by rollers, and is passed from the apron through rollers and is wound on a lap. —B.C.I.R.A.

Roller Drawing Head. U. Dittmar, Breisgau, Baden, Germany. E.P.249,714.

Subsidiary rollers are mounted between the drawing rollers of machines for spinning sliver from a carding engine, and their surfaces are slightly spaced from each other so that the slivers may be drawn without being positively clamped on the subsidiary rollers. The subsidiary rollers may be slightly reduced in diameter at their working surface, the reduction being not more than a fraction of a millimetre, and the working surface may be grooved circumferentially and the ends grooved longitudinally. —B.C.I.R.A.

Self-Weighting Drawing Roller. A. Lees and Co. Ltd. and R. Taylor, Oldham, Lancs. E.P.249,739.

A self-weighting drawing or drafting roller for textile machinery, of the kind in which a centrally fixed boss on the roller is connected to loose tubes mounted around the spindle on opposite sides of the boss by a leather covering, has the cover held firmly in position by providing on the boss a cavity or cavities into which the leather may be forced and thereby fixed in position. The leather covering may be burnt into the grooves and burnt over at the outer ends of the tubes. —B.C.I.R.A.

Roller Drawing Head. J. E. Lees, Oldham, Lancs. E.P.249,903.

A roller is mounted so as to exert pressure by its own weight, or by the additional weight imparted by an applied weight or spring upon sleeves which are freely mounted on axles so that the weight of the axle is not transmitted thereto, and which constitute the upper rollers of sliver drawing apparatus, or upon the barrels of axially aligned rollers, thereby ensuring their common rotation. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Preparatory Processes—

248,421. B. Sunderland. Balling apparatus for slivers from Noble combs.

248,913. Platt Bros. Ltd. and H. Nield. Guards for scutchers, beaters, openers &c.

249,196. T. D. Moore. Flax cleaning machine.

249,214. F. Spivey. Rotary fibre-spraying apparatus for oil.

Spinning—

249,253. O. Elliott. Thread guide and snarl catcher.

249,444. A. Trachsler. Spindle ball bearing.

249,975. J. & T. Boyd, Ltd. Spinning: Yarn severing device.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Weighting and Dulling Artificial Silk. W. Bruckhaus. *Text. Mfr.*, 1926, **52**, 240.

A translation from *Die Kunstseide*. Artificial silks are weighted by means of barium sulphate precipitated within the fibres by the double reaction between barium chloride and sulphuric acid, whereby their lustre is diminished so that they more closely resemble natural silk. Artificial silks may also be weighted with tin phosphate and silicates. —A.J.H.

(B)—Sizing

The Sizing of Yarns: Use of Quellin in Textile Mills. *Wool Record*, 1926, **29**, 1647.

Makers claim that quellin in dressing mixtures produces great binding power and suppleness of the finished material. It is soluble in cold water, and when mixed forms a thick gummy cream with pronounced adhesive and strengthening properties. It forms a powerful binding basis for other sizing ingredients, and in the case of medium and heavy sizing permits of the use of an increased percentage of China clay with a reduced quantity of starches, thus giving the required weights and cheapening the cost. Tests have shown that an increase of 25% in the breaking strain of yarns is produced when sized with quellin mixture. —B.R.A.W. & W.I.

Starch Solution: Preparation. P. Petit and Richard. *Compt. Rend.*, 1926, **182**, 657-659.

A clear solution of starch is prepared by passing starch paste six times through a vapouriser under a pressure of 1 kg. of air, carbon dioxide or hydrogen. The product filters through paper and has a molecular rotation of 210°. The properties of the solution on standing, on treatment with amylase and on boiling are described. From the cellulose residues obtained on boiling under pressure which behave as "condensed amyloses," the author concludes that these bodies exert a very strong protective action on the starch of the paste, and that they are removed by the mechanical action employed in preparing the solution. —B.C.I.R.A.

Diastatic Power of Malt. See Section 6.

(C)—Weaving

Healds: Manufacture. H. M. Lord. *Text. Merc.*, 1926, **74**, 413.

A general lecture on the selection of heald yarns and the care of healds. —B.C.I.R.A.

Shuttle-Truing Machine. Staubli Bros. Ltd. *Text. Mfr.*, 1926, **52**, 128-129.

A machine for truing worn shuttles and sharpening shuttle-tips is described. It enables shuttles belonging to the same loom to be trimmed to the same size and angle, and as the shuttle-tips are sharpened and polished to a gauge, the various shuttles of a loom make contact with the picker at the same point. —B.C.I.R.A.

Artificial Silk Warp Loom Fabrics. W. Davis. *Silk J.*, 1926, **2**, No. 23, pp. 47-48.

The production of striped and checked artificial silk fabrics on the warp loom is discussed. Knitted ties and girdles are produced in this way, and plain knitted blouse fabrics are being replaced by warp loom fabrics which show a finer mesh and are less liable to stretch and go out of shape. —B.C.I.R.A.

Loom Picker. *L'Avenir Text.*, 1926, **8**, 123-126.

A new type of reversible double-nosed picker for underpick looms is made from a strip of buffalo hide moulded and riveted to have two flat noses, two straight sides and a central opening varying in size with the type of loom and picking stick. The noses are furnished on the inside with thickening pieces of oak or chrome tanned leather which have convex surfaces adjacent to the opening. The convexity is calculated according to the arc described by the picking stick and the height of the picker on the stick. This convexity reduces the wear of the picker on the picking stick, and wear is reduced to a minimum by inserting guides of buffalo hide between the picking stick and the picking noses. The guides have a concave and a straight surface which exactly fit the convex surfaces of the leather thickening pieces and the straight surfaces of the picking stick. —B.C.I.R.A.

Braiding Machine. *L'Avenir Text.*, 1926, **8**, 126-134 (from *Moniteur de la Maille*).

A detailed account is given of an improved braiding machine which can be operated at greater speeds than the machines in general use. —B.C.I.R.A.

Knitting Machine Patterning Mechanism. J. B. Lancashire. *Text. Rec.*, 1926, **43**, No. 516, p. 71.

A short article on the principles of jacquard designing, dealing with the production of multi-colour effects on flat knitting machines. —B.C.I.R.A.

(G)—Fabrics

Non-Laddering Fabrics. J. Chamberlain. *Text. Mfr.*, 1926, **52**, 77-78.

The causes of laddering in knitted fabrics are discussed, and the constructions of so-called "non-laddering" fabrics are described. These may be made by using two separate yarns, one to give the required

effect on the surface and the other having greater weaving properties at the back. Compound weft stitches such as racked stitches, interlock, &c., are of a non-laddering type, but are not used to any great extent for hose because of their excessive weight. Non-laddering warp-knitted stitches have been in use for over 150 years. The chief objection to the use of warp fabrics of a close formation is that they are costly to produce owing to the slowness of production. Weft-knitted stitches such as the twisted loop stitch would furnish true non-laddering fabrics, but the methods in use for the production of this stitch are not simple. The stitch was used about 30 years ago for the production of hard-weaving underwear for the German Army. —B.C.I.R.A.

Patents

Improvements to Automatic Looms. Société des Ateliers Diederichs. F.P.589,833.

This apparatus, which permits the use of cops, is characterised by a turning magazine presenting a series of holes for the ends of the spindles. This magazine, which is usually stopped by a lock, is released by the hammer of the changing of bobbin, runs in a guiding to the point of the inferior spindle, and presents a new hole to the point of the following spindle. A brake device is added. —Bur. Text.

Metallic Fabrics. M. Rogé. F.P.592,201.

The fabrics are metallised generally by insufflation of metallic powders through a pistol. After this first operation the fabrics are bent between two cylinders and stretched on a table and dusted by a device which retrieves the particles of waste metal. The fabrics, then dull, are polished between two metallic rollers, turning at variable speeds, which produce a gliding and sliding. This patent describes various combinations of designs obtained by this process for articles of furniture and coating. —Bur. Text.

Looms: Warp Release. H. Gillet. F.P. 592,752.

This system is based on the principle of the transformation of a slow rectilinear displacement of a load in a quick circular motion which is alternately locked and unlocked by a light brake automatically actuated by a system determined by the angular motion of the beam in two directions at the time of closing and opening the shed. This system is suspended from the beam by an endless chain. —Bur. Text.

Needle Loom. J. Gabler. F.P.593,223.

Two bobbins of weft are disposed on each side of the loom. The two weft inserters are provided with means for giving and catching the weft (fork and hook), which can act alternately as givers or catchers. The needles themselves separate the warp. —Bur. Text.

Knitting Machine Bobbin. F. Fröhlich, Schleussig, Leipzig, Germany. E.P. 248,309.

A bobbin for a knitting or like machine comprises a cylindrical upper portion and a conical stepped lower portion, longitudinally slotted to receive bars which extend beyond the surface of the bobbin. The bars are held away from the bottom of the slots by a grooved disc. After the thread is completely wound the disc is removed and the bars are withdrawn to relieve the thread tension. The cylindrical upper portion is preferably covered with fabric, rubber or the like. —B.C.I.R.A.

Core-Covering Braiding Machine. W. Lusebrink and C. Ernestus, Donberg, Elberfeld, Germany. E.P.248,352.

The patent relates to machines for covering cores by winding and for simultaneously connecting them together at intervals by a braided covering. Hollow spindles mounted in a baseplate convey the cores. One spindle carries a rotary disc on which are mounted bobbins. The other spindle carries a toothed wheel which meshes with other wheels which drive annular toothed segments mounted on strikers carrying bobbins. Binding threads drawn from bobbins mounted on discs on the first spindle are threaded through eyes and are laid alternately on the threads from the bobbins on that spindle and those carried by the strikers. —B.C.I.R.A.

Knitting Machine Pattern Wheel. Lord Hollenden (S. H. Morley), G. and C. Hope-Morley, C. Morley, London, and G. Ball, Nottingham. E.P.248,437.

Pattern wheels and cams, for knitting and other machines, are constructed with the active cam surface composed entirely of segments adjustable on lines tangential to a circle about the axis of the pattern wheel or cam. The segments are arranged in the angle between a flange projecting from the body of the wheel and the periphery, and are supported by screw-studs entering slots in the flange, these slots being tangential to a circle of smaller diameter than the periphery. Each segment is also provided with an adjusting screw which bears on the periphery. —B.C.I.R.A.

Loom Change Box Motion. J. Pilling and Sons and T. Holt, Colne, Lancs. E.P. 248,494.

The cam or tappet operating the lever, rod and drop boxes is mounted on a short shaft, &c., driven by change gearing, including a compound change wheel whereby the speed of the shaft, relative to the speed of the loom, may be varied. The number of consecutive picks inserted by each shuttle can thus be varied. According to the provisional specification, carrier wheels are employed which are carried by a swinging arm or quadrant. —B.C.I.R.A.

Loom Jacquard. T. Dracup, Lane Close Mills, Bradford. E.P.248,534.

In order to cause all the warp threads to lie in one plane when lifted, the hooks are given an increasing lift from the front to the back of the harness, by making each hook successively shorter from the front hook to the back hook and by making the nebs of the hooks of such length that they lie in a horizontal plane when the hooks are in their bottom position. In a modification the knives are placed at different levels, the hooks being of the same length, and their nebs being graduated in length so that their ends are at the same distance from the tops of the knives when the hooks are in their lower position. —B.C.I.R.A.

Loom Picker. J. and J. Booth, Ramsbottom, Lancashire. E.P.248,584.

Pickers are formed from sheets of raw hide which have been partially tanned on both sides to form thin skins of leather but having a tough core. —B.C.I.R.A.

Multiple Fabric Loom. A. John, Gera-Reuss, Germany. E.P.248,600.

The warps for separate fabrics pass from a common warp beam over a guide beam, and the fabrics pass over separate breast beams to a common beam. One set of warps passes over a movable intermediate guide beam, the corresponding breast beam being also movable. If the weft of one warp breaks the other warp will be woven a few more picks before stopping. Means are provided for adjusting the warps before restarting. —B.C.I.R.A.

Shuttle Threading Device. C. Bourgeois, Rouen, France. E.P.248,675.

The threading device for loom shuttles according to Specification 242,611 is modified by having both ends rounded, an elongated window in the head which is made narrower than the body, and rounded entrance edges for the slit leading to the guide-eye. The weft is guided and held in the eye by the reduced portion of a lateral peg. An axial thread retaining slit for use during automatic threading is formed in the nose of the shuttle. —B.C.I.R.A.

Circular Knitting Machine Striping Mechanism. A. de Horevitz, Paris. E.P.248,695.

For producing vertically striped stockings, socks, &c., two kinds of needles differing in total length and in the thickness of their butts are provided. The length from the hook end to the top edge of the butt is the same for all needles. When the needles are raised by the cam surface, the hooks of one set are placed in such a position that they are able to take one yarn whilst the hooks of the other set, being raised to a higher level, are able to take both yarns. —B.C.I.R.A.

Circular Knitting Machine Patterning Mechanism. Scott & Williams Inc., New York, U.S.A. E.P.248,772.

Details are given of pattern control mechanism in which idling means for the operating ratchet pawl may cause the rotation of the pattern drum to be suspended at the completion of a cycle or at any desired point in the cycle. —B.C.I.R.A.

Heald Control Mechanism. C. Wilbraham, Manchester, and Hacking & Co. Ltd., Bury. E.P.248,857.

The healds are positively lowered or raised by means of tappets, &c., and are raised or lowered by means of springs, each heald being connected at two or more points by means of straps operating in the same vertical plane and pressing over pulleys to a lever, &c., rocking on a shaft within limits defined by a stop. Each lever, &c., is connected with a spring so arranged that when a spring is stressed and the corresponding lever, &c., is turned anticlockwise, the leverage through which the heald pulls on the levers, &c., increases, whilst the leverage through which the spring acts decreases. —B.C.I.R.A.

Lace: Weaving. C. Goodley, Nottingham. E.P.248,908.

To make filet net on a curtain machine provided with one set of spool threads controlled by a single bar at the same time as open and patterned work and combination effects, the bar moves one gait to the left when the carriages are in the back combs, then rests for a moment and moves two more gaits to the left. It moves similarly to the right when the carriages are in the front combs. The warp bar moves two gaits to the left, rests and moves one gait back whilst the carriages are in the back combs, and moves two gaits to the right, rests and moves one gait back whilst the carriages are in the front combs. The jacks can take up two operative positions. In one case open and patterned work can be produced by working the jacks in an ordinary way whilst a square or filet net or ground can be produced simultaneously in another part of the curtain by working the respective jacks as described in Specification 224,773. By moving alternate jacks in to intercept both spool and warp threads combination effects are obtained. —B.C.I.R.A.

Looms: Warp Let-off Motion. Soc. Anon. A. Saurer, Arbon, Switzerland. E.P. 249,124.

The warp passes from the beam over a back rest supported by arms connected by bars and cranks to a shaft furnished with levers acted on by springs. The arms are mounted on stud shafts carrying the warp beam, which can be driven by a member on a worm wheel geared to a worm on a shaft carried by one of the arms. When

the warp is used up and the arms move to the right two friction discs contact and the warp beam is rotated and continues to rotate until more warp is delivered than is required. When this occurs the back rest and arms move to the left under the action of springs, and the rotation of the warp beam is stopped until the excess warp is used up. —B.C.I.R.A.

Heavy Fabric Looms. J. H. and T. Hindle, Haslingden, Lancs. E.P.249,197.

In looms particularly for weaving heavy wide fabrics the lay, carried by one or more intermediate swords in combination with the ordinary end swords, is operated by one or more intermediate cranks on a crankshaft mounted in intermediate cross frames, to which are attached the front and back beams, so that the thrust in beating up is sustained by the back beam placing the intermediate frames in compression. The intermediate swords are shaped to clear the warps, are attached to the lay beam, and are loosely mounted on shafts supported on pairs of bearing brackets bolted to transverse rails. The crankshaft having the ordinary end cranks is provided with one or more intermediate cranks corresponding to the intermediate swords. The crankshaft is driven by an auxiliary driving shaft conveying power across the loom at two or more points by gears to reduce torsional deflection in the crankshaft. —B.C.I.R.A.

Loom Take-up Motion. J. H. Hindle and T. Hindle, Haslingden, Lancs. E.P. 249,198.

A take-up motion specially useful for wide, heavy fabric looms, comprises two smooth rollers driven in the same direction and at the same speed. The cloth passes then forward over an idle roller held tightly by the tension in the fabric against the peripheries of the two driven rollers, and backwards over the lower roller. Thence the cloth passes to a driven roller surmounted by a lap roller. The three moving rollers are driven through gearing operated by linked pawl and ratchet mechanism from a crank on a shaft rotating at crankshaft speed. —B.C.I.R.A.

Straight-Bar Knitting Machine. W. Cotton, Ltd., and C. H. Aldridge, Loughborough, Leicester. E.P.249,226.

A mechanism is described for the production of patterned fabric for fancy hosiery on machines of the "Cotton" type in which two supplementary carrier rods located in front of the narrowing machines are independently rocked and moved endwise under control of a pattern chain. —B.C.I.R.A.

Circular Knitting Machine Plating Mechanism. T. G. Whyte and T. Smith (trading as Whyte & Smith), Shepshed, Leicestershire. E.P.249,230.

Reverse plating effects are obtained by using two kinds of sinkers A and B, the length of the butt of B being longer than that of A, and a cam to give the sinkers B an additional movement and so reverse the relative position of the two yarns. The sinkers B are then quickly retired by a second cam to prevent them from drawing long loops. —B.C.I.R.A.

Circular Rib Knitting Machine Plating Mechanism. T. G. Whyte and T. Smith (trading as Whyte & Smith), Shepshed, Leicestershire. E.P.249,231.

Reverse plated effects are obtained in a rib machine by the use of a pair of tangentia yarn guides connected together so that when either guide is in position to feed the yarn which forms the ground the other guide occupies the plating position. The invention is described in connection with the type of machine with two cylindrical needle-beds. —B.C.I.R.A.

Loom Shedding Mechanism. W. Simmchen and Ipag International Patent Exploiting Co., Aussig, Czecho-Slovakia. E.P. 249,331.

Heald frames or bars are detachably connected at their ends by dowels or tenons to hangers, each of which is guided vertically by three guiding rollers. The hangers have racks meshing with toothed sectors of linked bell-crank levers operated by a dobby. The guiding rollers are mounted on spindles and are separated by discs of larger diameter. The hangers may be slotted to receive dowels or tenons on the heald frames or on ferrules on the heald bars; or the dowels may be carried by the hangers. —B.C.I.R.A.

Brake Lining, Clutch or Belt Fabric. G. A. Sowerby, Bentham, Yorks, and W. M. Angus, Newcastle-on-Tyne. E.P. 249,341.

A fabric for use as a lining for brakes or transmission bands or clutches has end portions which have faces woven on one side with warp and weft of material of greater resistance to wear than the warp and weft forming the rest of the face between the said end portions. Thus a woven strip may have at both sides an upper face formed of asbestos warp and asbestos weft, and a lower face of cotton warp and asbestos weft, whilst the centre part has an upper face of cotton warp and cotton weft. The lining may be impregnated. —B.C.I.R.A.

Loom Beat-up Motion. D. Kenyon and H. Evans, Great Harwood, Lancs. E.P. 249,388.

In a loose-reed loom the reed is locked to make the beat-up by adjustable wedge-pieces, on a slide rod, engaging between the inclined ends of reed-case levers and wedges underneath supported on an anchor-bar. Additional security is given by tapered locking pieces on the reed case spindle and the anchor-bar. The slide-rod is spring-pressed against an adjustable

cam-bar on the loom frame, so that it is moved to the left during the insertion of the weft to free the reed. If the shuttle encounters an obstruction the reed is thrown over to allow the shuttle to pass, and the reed is then swung back by a band lever on the reed case spindle without stopping the loom. —B.C.I.R.A.

Shuttle Peg. F. W. Bresges, Reydt, Rhineland, Germany. E.P.249,449.

A shuttle peg is slidably connected to its pivoted socket by screwed connection between the end of the peg and a spiral spring anchored near the opposite end of the socket. Relative movement between the two parts is limited by a pin and slot connection. —B.C.I.R.A.

Lucas-Lamborn Loom. Lucas-Lamborn Loom Corp., Manhattan, N.Y., U.S.A. E.P. 249,455 (from *Text World*, 1926, **69**, 3169).

The principle feature is the shuttle motion. Instead of being shot through the shed the shuttle is carried by means of two mechanical arms. The movement is imparted by a crank drive, the crank acting with a combination of levers to give a longer travel on one side of the centre than on the other, so that the shuttle starts at slow speed, increases, then slows down. The shuttle is transferred from one carrier to the other at the centre, the transfer arrangement being effected by a latching mechanism tripped to release the shuttle from one arm and engage it in the other. The shuttle is equipped with a positive tension device consisting of a lever which gives constant tension, irrespective of the size of the package left in the shuttle. The shuttle carries a much larger package of yarn than usually, and the opening of the shed is wider than that generally employed; strain on the warp is absorbed by a compensating whip roll. Contact between the shuttle and the warp is eliminated. —B.C.I.R.A.

Looms: Pirnless Weft-Inserter. A. Mullor, Seine, and L. Carriol, Paris. E.P.249,471.

The weft is inserted in loop form from each side of the loom by means of a "shuttle" or weft carrier cut away at its upper side and provided with a transverse spindle. A rocker pivoted on the spindle is provided with two plates or strikers and two forks. Its movements are limited by pins and controlled by a spring. The weft is led from spools at each side of the loom to eyelets on rockers which are controlled by cam and lever mechanism and are provided with abutments for actuating the plates and hooks of the spindle rocker, and with thread-gripping hooks. When the "shuttle" is shot to the left the raised rear fork engages weft from the right-hand spool and takes it in loop form through the shed. The weft thread is freed from the "shuttle" by the rear plate striking the abutment whereby the rocker is swung, allowing the weft thread to fall on and be retained by the left-hand thread-gripping hook. At the same moment weft from the left-hand spool is engaged by the shuttle hook and drawn to the right. —B.C.I.R.A.

Circular Knitting Machine Pattern Wheel. Soc. Etablissements Lebocey Frères, Seine, France. E.P.249,486.

A toothed wheel gearing with a perforated steel band is substituted for the usual pattern wheel. A line of irregularly spaced perforations registers with a swinging arm controlling thread guides or other devices and having on it a projection. As the band travels downwards a spring holds the arm in a position where the perforations register with the projection on the arm. The unperforated parts by acting on the top edge of the projection force the arm away from the wheel. Larger sized patterns than would be obtainable by the use of an ordinary pattern wheel can thus be produced. —B.C.I.R.A.

Looms: Anti-Balloon Shuttle Construction. A. and J. Calvert, Blackburn. E.P. 249,985.

To prevent ballooning, &c., a shuttle body is continued around and in proximity to the end of the skewer. For this purpose the slot in the shuttle is of keyhole section, one part being wide enough to pass the skewer and the other part being of circular or other shape. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Weaving—

248,348. W. Harris. Warp let-off device.

248,362. E. Zattera. Cop-changing mechanism.

248,484. J. E. Grosvenor and W. T. Picking. Looms: Comber-board.

249,392. E. Hollingworth. Carpet jacquards.

249,582. Clark & McKee, Ltd. Fabrics from horsehair &c.

249,729. W. Gledhill. Looms: Warp let-off weighting device.

Knitting—

249,731. E. A. Hirner. Knitting device to permit use of undyed yarn in heel, foot, and toe of half-hose.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming

Scouring and Dyeing of Artificial Silk. E. Greenhalgh. *Dyer and Calico Printer*, 1926, **56**, 52-53.

The scouring, dyeing and finishing of knitted artificial silk fabric (tubular and

flat) is described. Palmer and Hunt blanket finishing machines are suitable, and cause no distortion of the fabric. —A.J.H.

Bleaching and Blueing Silk. C. Zentsch. *Dyer and Calico Printer*, 1926, **56**, 36-37. (From *Silk*.)

A description of methods for degumming and bleaching natural silks. Cyanol extra, Acid Violet, Quinoline Yellow, Patent Phosphine, and Chrysoidine are suitable dyes for tinting bleached silks. —A.J.H.

(C)—Washing

Wool Washing and Its Bye-Products. M. Rindl. *S. African J. of Industries*, 1923, **6**, 628.

The amount of potash present in wool depends largely on the breed of the sheep. Results are recorded of experiments on Australian merino wools, where only 2·3% of potash have been obtained by extracting with cold water, but between 4·5 and 6·25% from stained pieces and locks, and this makes extraction profitable in Australia on account of the excessive price of potash fertilisers. Very little potash is recovered in England, but in France the wool scoured yields quite a profitable amount. A method of extracting potash salts used in the United States is to allow washings from certain slaughter-houses to run through peat, which absorbs the potash, the material then being used as a filler for certain complete fertilisers. In Belgium, France and Germany the wool is subjected to preliminary treatment with cold water on the counter-current principle; the solution is allowed to circulate until it attains a specific gravity of 1·12. This is evaporated nearly to dryness in iron pans, and the pasty mass is calcined in reverberatory furnaces or destructively distilled in clay gas retorts. The carbonaceous residue is crushed, lixiviated in iron or wooden vats, and the clear liquid evaporated, furnishing successive crops of potassium chloride and carbonate. Statistics are given relative to potash recovery and the wool washing activities in the Union are recorded. —B.R.A.W. & W.I.

(E)—Drying and Conditioning

Hank Drying and Conditioning Machine. Plews & Turner. *Text. Merc.*, 1926, **74**, 340-341.

The main essentials of the machine are a hot-air chamber, a series of poles on which the hanks are hung while under treatment, an endless chain operated for conveying the hanks through the drying chamber, and a special arrangement for blowing hot air on to the hanks in such a way that both sides of the hanks are treated, thus obtaining a maximum drying and conditioning effect. The machine is simple in operation, easily controlled, and its first cost is low. —B.C.I.R.A.

Artificial Silk Drying Machine. Tomlinsons, Ltd. *Text. Merc.*, 1926, **74**, 300.

The machine is of the chamber type, especially designed for drying artificial silk on stretcher frames. It may comprise two, four or more chambers, separated by small compartments which are divided by a partition into two heating chambers. The fans are also double, one half drawing air into the heating compartment and the other half impelling it forward into the next drying chamber. The chambers are charged in turn at regular intervals, and the opening and closing of all valves is automatically controlled by opening and closing the doors in removing the dry yarn and inserting the wet yarn. —B.C.I.R.A.

Cheese Drying Machine. *Text. Rec.*, 1926, **43**, No. 517, p. 96.

The machine has been designed for drying yarn in the form of cheeses, spools, bobbins and cops. The convection principle of drying is employed, air at a high temperature being used to induce the moisture to come through the mass of yarn for removal by the hot air which continuously passes over and round it. The cheeses, &c., are mounted on metal rods, and the drying process is assisted by the heat of the air conducted to the centre of the cheeses by the rods. The rods are mounted on a pair of endless chains near their centre, so leaving the ends free. The chains, following a sinuous path, travel from end to end of the machine six or more times as desired. On the last passage through the drying chamber the dry yarn meets a current of cool air and is gradually cooled before emerging from the machine. —B.C.I.R.A.

(G)—Bleaching

Importance of Dye Fastness to the Bleacher. See Section 4I.

(H)—Mercerising

High-speed Mercerisation of [Cotton] Piece Goods. T. P. Gates. *Dyer and Calico Printer*, 1926, **56**, 14-16.

The results are given of a systematic investigation of the influence of concentration, temperature, and purity of the caustic soda lye, twist in the yarn, the preparation of the fabric, the moisture-content of the fabric, and sketching in the mercerisation of cotton piece goods. Caustic soda of 19% (by weight) yielded the best results, especially at temperatures exceeding 25° C., and saturation with caustic soda for 30 secs. is sufficient, regardless as to whether the fabric consists of hard or soft spun yarns. Non-scoured fabrics are difficult to mercerise owing to the resistance exerted by impurities to penetration of the fabric by the caustic soda. —A.J.H.

(I)—Dyeing

Turkey-red Oil and Its Competitors. H. Pomeranz. *Text. Mfr.*, 1926, **52**, 241-242 (from *Leipziger Monats.*).

A description of methods for preparing Turkey-red oil by the sulphonation of castor oil. —A.J.H.

Straw Bleaching and Dyeing: Modern Methods. C. Williams. *Dyer and Calico Printer*, 1926, **56**, 12-13.

A description of methods for dyeing plait, braids and trimmings containing cellulose acetate silk with Celatene dyestuffs. —A.J.H.

Three-Colour Effects on Fabrics Containing Acetyl Cellulose. H. Kay. *Dyer and Calico Printer*, 1926, **56**, 25.

Methods for dyeing textile materials containing cotton, cellulose acetate silk and wool in three colours in one or two baths are described. Neutral dyeing acid colours, direct cotton dyes, and the usual dyes for cellulose acetate are used. In the two-bath process, the cotton is dyed last at a temperature not exceeding 30° C., so that the wool remains unstained. —A.J.H.

Mechanism of Dyeing. A. Brass. *J. Soc. Dyers and Col.*, 1926, **42**, 168 (from *Z. Angew. Chem.*, 1925, **38**, 855).

The author has carried out dyeing trials with Indanthrene colouring matters (blue, orange, golden orange and yellow), treating cotton with the dye vat in atmospheres of nitrogen and of carbon dioxide. He has tested the patterns before and after oxidation with boiling soap solution, and arrives at the conclusion that the vat acid has an affinity for cotton, but that its alkali salt has not. An excess of alkali in the vat will be unfavourable to the liberation of hydrolysis of the vat acid, and will impede the dyeing process, as has actually been found to be the case in Indigo dyeing by Binz and Rung. —L.I.R.A.

Sulphonated Oils. J. B. Crowe. *Dyer and Calico Printer*, 1926, **56**, 34-36.

The preparation, uses and analysis of Turkey-red oils are described. —A.J.H.

Textile Dispersants. *Dyer and Calico Printer*, 1926, **56**, 48.

A brief discussion of dispersing agents and their application in dyeing and printing. Oranit is suitable for assisting the solubility of vat dyes in dyeing, and Oranit BF in printing; Oranit FW is suitable for adding to acid dyebaths (for wool), and Oranit CC is an excellent dispersing agent for basic dyes. Cykloran FC is a good substitute for oleine in the preparation of solutions of Naphthol AS compounds. —A.J.H.

Developments in Calico Printing. R. Sansone. *Dyer and Calico Printer*, 1926, **56**, 50-51.

An account of plant used for naphthol-preparing fabric before dyeing with developed colours. —A.J.H.

Dyeing Satins in the Piece. L. J. Matos. *Dyer and Calico Printer*, 1926, **56**, 51.

High quality satins having a real silk face are dyed while mounted spirally upon a chiffon dye reel; abrasion of the face is thus avoided. —A.J.H.

Batik Dyeing. P. Mijer. *Dyer and Calico Printer* 1926, **56**, 54-55.

Detailed description of methods employed by natives in Java for producing batik effects on cotton materials. The batik art was practised in Java at least as early as 1563. —A.J.H.

Dyes: Fastness. R. P. Foulds. *Industrial Chemist*, 1926, **2**, 147-149.

Discussing the importance of dye fastness to the bleacher and finisher, the author suggests that it would be a great advantage if some standard of the fastness of a colour to every influence under which it may come could be worked out and adopted throughout the trade. Such a step would necessitate the co-operation of dye makers, dyers and merchants, and launderers. —B.C.I.R.A.

Some Aspects of the Development of Dyes for Cellulose Acetate. A. J. Hall. *Dyer and Calico Printer*, 1926, **56**, 26-27.

A description of methods which have been used for dyeing cellulose acetate silk, reference being made to processes of pretreatment with alkalis (saponification) and swelling agents (e.g., ammonum thiocyanate) and to Ionamines and S.R.A. dyes. The solid-solution theory of dyeing cellulose acetate silk is supported by reference to the absorption by this silk of *o*-nitroaniline from aqueous, it being shown that *o*-nitroaniline is about 180 times more soluble in cellulose acetate silk than in water. —A.J.H.

Dyeing of Artificial Silk. See Section 4B.

(J)—Printing

Cotton Cloth: Hand Printing and Painting. D. M. Amalsad. *Indian Text. J.*, 1926, **36**, 141-144.

Details are given of the arts of block printing and hand painting on cotton cloth as practised in Madras. —B.C.I.R.A.

Use of Dispersing Agents in Printing. See Section 4I.

(K)—Finishing

Dyes: Application. J. Ferguson. *Industrial Chemist*, 1926, **2**, 177-180.

The importance to the textile finishing trades of keeping in touch with progress in foreign countries is emphasised, and recent advances in dyeing and printing as indicated by the pattern cards issued during 1925 are discussed. —B.C.I.R.A.

Finishing of Artificial Silk Fabrics. See Section 4B.

Importance of Dye Fastness to the Finisher. See Section 4I.

(L)—Waterproofing

Copper Soap: Preservative Action. W. R. G. Atkins. *J. Marine Biol. Assoc.*, 1926, **14**, 63-69.

The paper describes the efficacy of copper soap dissolved in petrol or benzole as a preservative for fishing nets against the bacterial action of sea water and tendering by sunlight. Experiments on cotton and linen fabrics are also mentioned.
—B.C.I.R.A.

Patents

Formaldehyde-Aniline Condensation Products: Application. Comp. Nat. de Mat. Col. et Manuf. de Prod. Chim. du Nord Réunis, Etabl. Kuhlmann (from *Brit. Chem. Abstr.*, 1926, B, 536). F.P. 595,705.

Cotton is dyed in brown shades fast to washing, alkali, chlorine, and light by impregnation with a solution containing products obtained by the condensation of formaldehyde and aniline or its homologues in acid solution, being afterwards passed through a solution of caustic soda or sodium carbonate, then washed, oxidised with a dilute solution of sulphuric acid containing a dichromate or persulphate, washed and soaped. The resulting shades may also be diazotised and developed with β-naphthol or coupled with diazo compounds. Alternatively cotton is impregnated with a solution containing lactic acid, the above described condensation products, sodium chlorate, sodium acetate, and copper sulphate or a vanadium salt, then oxidised during six hours at 40° with a solution of a dichromate. White and coloured resists may be obtained by after-printing with a reducing agent such as a sulphite, bisulphite or hyposulphite and suitable dyes. Brown effects are also obtained by printing cotton fabric with a paste containing the condensation products and gum tragacanth thickening, drying, fixing in an alkaline solution, and developing the shade by oxidation with a persulphate. Alizarin and vat dyes may be printed and developed simultaneously by oxidation. —B.C.I.R.A.

Dyes: Fixing. M. Scholz. U.S.P. 1,544,603 (from *Chem. Abs.*, 1925, **19**, 2750).

The colours are fixed in dyed materials by quickly passing them through a hot aqueous saline solution containing a small proportion of acetic acid. —B.C.I.R.A.

Cloth Printing Machine. E. Cadgene and G. Dupont, New Jersey, U.S.A. E.P. 248,254.

A textile fabric is decorated by feeding it past an engraved roller supplied with a colouring composition which is removed from the roller and sprayed on to the fabric by means of a rotating brush. A stencil may be interposed between the spray and the fabric. The web is dried between heating coils, arranged in a drying chamber, and rewound on a reel. —B.C.I.R.A.

Cloth Folding Machine. J. Montforts, Munchen, Sladbach, Germany. E.P. 248,558.

The patent relates to the mechanism for reciprocating the folding arm carriage, the method of securing the folding blades, and the cloth-guiding table. —B.C.I.R.A.

Drying Cylinder Gear Box. W. P. Evans, Swinton Park, Irlam-o-th'-Height, Lancs. E.P. 248,568.

The gear box of each of a series of steam-heated rotary drying cylinders is provided with a bearing for the cylinder trunnion, a horizontal bearing transverse thereto for the driving shaft, a cover to enclose the bevel gears, and an oil well into which the gears dip. One of the bevel gears is suitably keyed to the trunnion so as to allow the latter to move longitudinally due to expansion and contraction, against a spring which is held against the trunnion by a stirrup and screw. —B.C.I.R.A.

Dyeing Machine. British-American Laundry Machinery Co., Victoria Street, Westminster. E.P. 248,793.

In dyeing, washing and like apparatus, a foraminous drum for receiving the material to be treated is rotatably mounted within a stationary casing containing water or other liquid, the drum being radially spaced from the container around its whole circumference at a sufficient distance to enable dyeing, blueing, bleaching, or other liquid injected by steam through a perforated pipe to be sufficiently mixed with the water in the container before passing to the drum. The water is initially heated by steam passed through pipes at opposite ends of the container to perforated pipes in the bottom of the container. At the junction of one of these pipes with its supply pipe an injection casing is provided which also communicates with a tank containing the dyeing or other treating liquid. When the water has been sufficiently heated a valve is opened and

the treating liquid is injected by steam into the water. When the dyeing, &c., operation is complete, valves in the steam supply pipes are closed and the treating solution is drained from the container. The perforated pipes may then be cleaned out by opening the steam supply pipe valves and the outlet pipe valves. —B.C.I.R.A.

Vat Dye Leuco Compounds: Application. J. I. M. Jones, B. Wylam, and J. Morton, Lancaster, and Morton Sundour Fabrics, Ltd., Carlisle. E.P.248,802.

Leuco compounds of vat dyes are converted into stable derivatives by treatment with phosphorus oxychloride or alkylphosphoric halides in the presence of a suitable basic body, tertiary amines being specified. The reaction may be carried out in the presence of a solvent or diluent such as monochlorobenzene or carbon disulphide. The products may be used for dyeing and printing cotton, wool, silk, artificial silk, hemp, raffia, &c., being converted on the fibre into the original vat dyestuffs by mild acid oxidising agents such as an acid solution of ferric chloride. Examples are given of the preparation of compounds from the following:—Leuco flavanthrone and phosphorus oxychloride in the presence of carbon disulphide and pyridine; leuco indanthrone and phosphorus oxychloride in the presence of chlorobenzene and pyridine, &c. Methylphosphoric dichloride is obtained by treating methyl alcohol with phosphorus oxychloride and fractionally distilling the product, first under reduced pressure and then at ordinary pressure. —B.C.I.R.A.

Cloth Singeing Machine. E. Turner & Co., Manchester. E.P.248,810.

A singeing machine comprises a plurality of gas burners arranged to project stable oxidising flames horizontally on to one or both sides of, and uniformly across, the vertically moving fabric, each burner having a single outlet extending the full width of the machine. In one form, the burners are arranged alternately on opposite sides of the frame, the fabric being led down between brushes and the burners, and then through a steaming-box and mangling rollers to a plaiter. A perforated pipe, secured to or resting on a baffle plate above each burner, is adapted to project heated air on to the fabric to remove the combustion products, and two perforated pipes communicating with an exhaust fan remove any charred matter from the fabric after passing the last burner. In a second form the burners are all arranged on one side of the frame, the fabric being led over guide rolls and preferably over a singeing plate when both sides of the fabric are treated. An air heater supplied from a casing, through which flue gases may be led, may be provided to dry the fabric. The burners are preferably constructed as in Specification 249,454. —B.C.I.R.A.

Metallic Powder Ornamented Fabrics; Preparation of——. Soc. Nouvelle de Metallisation, Paris. E.P.249,167.

Textile fabrics are decorated by means of metallic powder sprayed on to the material through a stencil, a sheet of wire gauze being interposed between the stencil and the material. The material may further be treated by dyeing or finishing, also metals of different kinds and colours may be used for various parts of the design. —B.C.I.R.A.

Yarn Dyeing Apparatus. W. J. Mellersh-Jackson, London, for Fuld and Hatch Knitting Co., U.S.A. E.P.249,369.

Yarn is lifted periodically by a rocking arm as it is passed continuously over a wick extending through an opening to the upper surface of a tank which is kept full of dye liquor. The liquor is supplied through a pipe to one end of the tank and excess overflows through an aperture into an outer receptacle, the cover of which supports the tank. The method of operating the rocking arm is described. —B.C.I.R.A.

Dyeing, Mangling, and Wringing Apparatus. T. McConnell, Easthampton, Mass., U.S.A. E.P.249,406.

Yarn, fabric, or other material is fed loosely over a top roller down through an oscillated guide tube and into a dyeing vat. A steam pipe is provided in the chamber beneath the perforated false bottom of the vat from which the dye is withdrawn and circulated by a pump. The yarn is fed down channels formed by guides on the inclined bottom of the vat, and is then passed over a roller above the dye surface, which is rotated at the same speed as the top roller, to a series of angular rollers. Each roller comprises a spider covered with sheets, so that during the passage of the yarn superfluous dye is expressed and the yarn is stretched longitudinally. —B.C.I.R.A.

Yarn Polishing Device. T. McConnell, Easthampton, Mass., U.S.A. E.P. 249,407.

A machine for treating yarn or cloth to produce a soft silky texture comprises feed and delivery rollers, and polishing members comprising spiders carrying arrow-headed arms provided with facings of wood or other polishing material. The polishing members are arranged so that their arms interlock and divert the material, stretched between the feed and delivery rollers, from the straight line as it passes between them. The speed of the polishing members is greater than that of the feed of the material. —B.C.I.R.A.

Differently Sulphured Fabric: Application. Naamlooze Vennootschap Nederlandsche Kunstzijdefabriek, Arnhem, Holland. E.P.249,538.

Contrasting lustre and dyeing effects in fibres are obtained by arranging that the

sulphur content of the fibres varies at different points. The material may be prepared by adding sulphur or by desulphurising to the extent desired. With viscose artificial silk, by using a mild desulphurising agent, only the sulphur at the surface may be removed, that in the core remaining untouched. On subsequently dyeing a material so treated there is obtained a lustrous coloured fibre; alternatively, only the outer surface of the fibre may be dyed, the sulphur in the core being either removed or allowed to remain, in which case there is obtained a dull coloured fibre. The process is applicable to the treatment of piece goods; thus the goods may be woven with uniformly sulphured fibres, the sulphur being subsequently removed in selected places either by a sulphur dissolving paste or liquid or by printing with a sulphur fixing agent, such as wax, and then removing the sulphur from the unprinted portions. The dyestuff may be incorporated in the sulphur fixing or dissolving medium. —B.C.I.R.A.

Fabric Breaking Machine. J. Poole, J. E. Whitehead, and Whitehead & Poole, Ltd., Radcliffe, Lancashire. E.P. 249,733.

In a fabric breaking machine of the kind described in Specification 7074/08, a pair of breaking members having annular, axial, or helical interengaging projections and grooves is employed in addition to the pairs of scrolls. The breaking rollers, preferably geared together, are mounted on arms in fixed bearings respectively, the arms preferably being operated synchronously with the arms carrying the outer scroll members, or they may be adjustably mounted on fixed arms. The shaft carrying one of the breaking rollers, which may be composed of independently adjustable parts, is mounted in bearing blocks independently adjustable in the forked ends of the mounting arms. The bearings of the shaft are preferably of the self-aligning kind, so that the shaft may be arranged at an angle to the shaft carrying the second breaking roller. A modification is described. —B.C.I.R.A.

Acid-Dye Sensitised Cotton Fabric: Preparation. P. Karrer, Zurich, Switzerland. E.P.249,842.

Cotton textile materials previous to dyeing are treated in such a manner as partly to esterify the cellulose with aryl or alkyl sulphonic groups, particularly benzene-, toluene-, or naphthalene-sulphonic groups, and are then heated with a solution of ammonia, or of an aliphatic or aromatic amine, or of hydrazine or a hydrazine derivative. Material so treated becomes capable of being dyed with acid dyestuffs. In an example, cotton partly esterified with *p*-toluene-sulphonic groups, is heated in an autoclave with aqueous ammonia solution; the cotton so treated can be dyed with tartrazine, OrangeII., sulphorhodamine, &c. —B.C.I.R.A.

Fabrics: Waterproofing and Gasproofing. British Celanese, Ltd., London, T. C. Woodman, Teddington, and W. A. Dickie, Spondon, near Derby. E.P.249,946.

Waterproof or gasproof fabrics are formed by subjecting to heat and pressure woven, knitted or other fabrics made wholly or in part of yarns or threads of filaments or fibres of cellulose esters or ethers or mixtures thereof. The fabric may first be coated or sprayed with, or there may be incorporated with the filaments or fibres, plasticising or softening agents or solvents, such as triacetin, paratoluene sulphonamide or its derivatives, diethyl phthalate, paratoluene sulphonanilide, or high boiling alkylated xylene-sulphonamide derivatives. The softening agents are employed particularly for making gasproof fabrics. Various means of applying the heat and pressure are indicated, and the extent of the melting effect to be produced on the filaments or fibres of the cellulose derivative may be varied by varying the conditions of temperature, pressure or duration of pressure. A fabric made entirely from cellulose acetate yarn, for example, may be pressed between smooth plates at a temperature of 100° C. under a pressure of 500 lb. per sq. in. for five minutes to give a waterproof fabric which retains the structure of the woven fabric. Or the fabric may be passed slowly through heated calender rollers at a temperature of 100-180° C. under a pressure of 300-600 lb. per sq. in., or be passed repeatedly between the heated rollers. In order to increase the melting effect produced on the fibres the fabric may first be treated with a solution of 20 grams of monomethyl-xylene-sulphonamide in 100 grams of benzole for each 100 grams of fabric, and the temperature, pressure, or duration of pressure may be increased to cause the fibres to coalesce more or less completely. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Finishing—

248,366 } Waggon und Maschinenbau A.-G.
248,367 } Fabric guiding device.

248,511. W. Battye. Tentering machine.

249,434. Havannah Mills Co. and G. Roger. Cloth tensioning device.

Dyeing—

248,814. Chem. Fabr. Pott & Co. Sulphonic acid compounds: use in textile processes.

249,413. J. & R. Whitaker. Dye vat construction.

Scouring—

249,496. A. Rechberg and G. Braun, Ges. Degreasing process for textiles.

5—LAUNDERING AND DRY CLEANING

Patents

Detergents. J. J. Richardson and J. Richardson, Kingston-upon-Hull. E.P. 249,207.

Saponaceous cleaning compositions for wood, metal or paintwork and for removing stains from carpets, fabrics, &c., consist of soap, soda-ash, waste-lime from water-softening plants, and water, with or without an abrasive. In an example, 9 lb. of stearine soap, 5 lb. of soda ash, 15 lb. of silver sand, 37 lb. of water, and 34 lb. of the waste-lime resulting from the softening of water by passage through an iron tank packed with shavings impregnated with lime, are used. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Detergents—

248,209. R. G. Varcoe. Saponaceous cleansing composition.

249,912. C. W. Fulton and H. W. Hulton. Cleansing compositions.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Oil Film: Spreading on Water. A. Marcelin. *Ann. de Phys.*, 1925, **4**, 459-527.

The paper is an experimental analysis of the physical state of floating so-called "unimolecular" films as typified by a film of oleic acid on water. The author applies the terms "surface solution" or "two-dimensional fluid" to extremely thin films of this type. It has previously been suggested that the spreading of a fatty film, which is known to be of the order of unimolecular dimension, is limited to the juxtaposition of the molecules of the fat on the surface of the water. The author considers that the supposition of a limit of spreading is due to insufficiently sensitive apparatus and shows that the spreading of matter, notably of oleic acid, on water may be unlimited; he has detected a film 14 times more expanded than those which had been believed to have attained their limit of area. In such an expansion the film is necessarily discontinuous; like a gas or vapour of which the molecules are not connected in the volume occupied, it exerts against its contour a "surface pressure" which is equal to the lowering of the surface tension of water (caused by the film). The author finds that the variations in the surface pressure p of a film of oleic acid in terms of its area S are represented by a Mariotte's Law, $pS=\text{const.}$, and that the variations in the product pS as a function of temperature are represented by a Gay-Lussac Law $pS=KT$. As a vapour on compression is resolved into a mist of droplets, so fatty matter in the state of a surface film on water is condensed in the form of droplets or discs when the area is progressively reduced; the appearance of the first droplets corresponds on the curve $p=f(S)$ to a peak which is succeeded by a level (signifying a change in physical state), of which the constant ordinate measures the "saturated surface pressure" of the film. The experimental work is described in detail and values obtained for the saturation pressure of a number of organic substances. For oleic acid Ps=40 dynes/cm. —B.C.I.R.A.

Cellulose: Action of Concentrated Hydrochloric Acid. K. Atsuki. *Brit. Chem. Abstr.*, 1926, **45**, B8 (from *Cellulose Ind., Tokyo*, 1925, **1**, 53-61).

Cotton cellulose was treated at 10° with 100 times its weight of hydrochloric acid at 40, 41, 43 and 45% strength, and the course of the hydrolysis was followed by measurements of viscosity and specific rotary power. The increase in rotation is more rapid the higher the concentration of the acid. The rotation-time curves show two points of deflection, the first after about five hours with 45% acid or ten hours with 40% acid, and the second after 15 hours with 45% acid, or 30 hours with 40%. The viscosity falls rapidly along the first step of the specific rotation curve and remains constant afterwards. The addition of 1% of zinc chloride or 0·5% of sodium chloride to the acid retards the solution of the cellulose and inhibits to some extent the hydrolysis. The addition of 0·5% of calcium chloride suppresses the solvent action of the hydrochloric acid, the cellulose being disintegrated to a powdery form after a few days. The solution of cellulose is considered to take place by its association with the hydrochloric acid in virtue of its hydroxyl groups reacting as water as long as the concentration of the acid is such that it is still unsaturated with water of hydration; dispersion of the cellulose under these conditions is progressive. The end product of the hydrolysis is dextrose, the intermediate products being colloids and then crystalloids in stages. By precipitation at an early stage after solution the cellulose is obtained in a modified form very highly hydrated. It is physically unsuitable for nitration or acetylation but can be centrifuged and converted into viscose. —B.C.I.R.A.

Cellulose Palmitates: Preparation and Properties. G. Kita, T. Mazume, I. Sakurada, and S. Nakajima. *Brit. Chem. Abstr.*, 1926, **45**, B45 (from *Cellulose Ind. Tokyo*, 1925, **1**, 227-232).

Only a slight degree of esterification is obtained by heating cellulose with palmitic anhydride in the presence of pyridine and chloroform. On the other hand, when cellulose is heated with palmityl chloride and pyridine, preferably diluted with benzene, progressive formation of esters takes place, with the ultimate production

of cellulose tripalmitate soluble in benzene or ether. The esters are purified by washing the product with alcohol and extracting with ether or benzene. The monopalmitate is still fibrous and only slightly swollen; the higher palmitates, whilst retaining a fibrous structure are very much swollen and completely deformed. The tripalmitate from hydrocellulose is completely soluble in ether, that from normal cellulose only partly soluble. The dipalmitate from hydrocellulose is soluble in benzene, but that from normal cellulose only partly. The mono-palmitate is insoluble in benzene but becomes transparent in that liquid. The solutions from ether or benzene deposit elastic films. The melting points, ranging from 180 to 220°, are lower in the esters from hydrocellulose than in those from normal cellulose. In the analysis by saponification, the addition of benzene to the alcoholic potassium hydroxide promotes the reaction.

—B.C.I.R.A.

Takadiastase: Constitution. S. Nishimura. *Chem. Zentr.*, 1925, **ii.**, 2212 (from *Chemie der Zelle u. Gewebe*, 1925, **12**, 202-216).

The following enzymes were detected in a takadiastase investigated by the author—Amylase, saccharase, maltase, proteases, catalase, lipase, rennet ferment, lactase, inulase, sulphatase, and amidase. At *p*H 6·0, amylase, saccharase, maltase, proteases, catalase, and lipase could be quantitatively adsorbed by colloidal alumina. The adsorption of the other enzymes was not investigated. The enzymes were liberated by treatment with a phosphate mixture at *p*H 8. Accompanying substances were separated by this treatment since the activity of the enzymes in the final solution was some three times as great as in the original solution. The same increase of activity was noted for all the enzymes. Separation of the enzymes in this way has not been attained. If the final solution was adjusted to *p*H 6 the enzymes could be readsorbed by alumina and the enzymes liberated from this second adsorption differed in their behaviour in that their activities were increased to different extents. Their activities after the second adsorption and liberation as compared with those in the original solution were increased to—Amylase 7·0, saccharase 4·63, maltase, 5·05, proteases 5·53, and catalase 10.0. —B.C.I.R.A.

Tannin: Light-protective Properties. P. S. Meyer and S. Amster. *Chem. Zentr.*, 1925, **2**, 415 (from *Klin. Wehschr.*, **4**, 921-923).

Tannin in 10% vaseline admixture or in 10% alcoholic solution affords an efficient protection from the effects of strong sunlight which are injurious to the skin of some individuals. The protective effect of tannin lasts for some hours and is ascribed to colloid-chemical structure changes in the skin constituents. —B.C.I.R.A.

Colour: Measurement. W. G. Raffé. *Science Progress*, 1926, **20**, 662-674.

A plea for a simple, standardised method of measuring and expressing colour for industrial purposes. —B.C.I.R.A.

Zinc: Estimation. R. Strebinger and J. Pollak. *Microchemie*, 1926, **4**, 15-18.

The micro-determination of zinc, manganese and cobalt by precipitation as pyrophosphate is described. —B.C.I.R.A.

Textile Fabrics: Ultra-Violet Transmission. F. W. Alexander. *Analyst*, 1926, **51**, 54 (from *Special Report by the Medical Officer of Health to the Metropolitan Borough of Poplar*, Oct. 1925).

The apparatus indicates by the degree of fluorescence the intensity of the ultra-violet rays in the radiation emitted from quartz mercurial vapour lamps. The principle adopted is that of an "extinction photometer," ultra-violet rays being allowed to enter a box, in the form of a camera, through a Chance filter, and the extinction point being controlled by means of an iris diaphragm manipulated by a metal arrow pointing to an arbitrary scale for recording purposes. A reflector of silver-plated copper is fixed at an angle of 45° in front of the iris. A focussing wire is provided on the eye-piece side of the iris diaphragm. The diaphragm is fixed close to the Chance filter, which must be sufficiently thick to exclude all visible light and must be polished on both sides. The fluorescent screen is of uranium glass, and can be replaced by a frame carrying a piece of "Seltona" paper, so that a photographic shade of the ultra-violet rays, with and without reflector, can be recorded. Textile fabrics were found to transmit the near ultra-violet rays in the following order—expensive make of artificial silk; jap silk and silk stockings; nainsook and very cheap cotton stockings; fine linen. Long cloth and calico allowed some ultra-violet rays to pass, and unbleached calico gave just perceptible transmission.

—B.C.I.R.A.

Cellulose: Bacterial Decomposition. A. C. Thaysen, W. E. Bakes, and H. J. Bunker. *Biochem. J.*, 1926, **20**, 211-216.

Experiments are described which indicate that micro-biological activity is insufficient to eliminate all the cellulose present in plant tissues decaying to form peat. The humic compounds which may be obtained from typical peats consist of two different types, one of which yields a chlorine derivative identical with, or very similar to, that of "natural humus" (lignin humic compound), whilst the chlorine compound of the other is closely related to that of the artificial humus compounds obtainable either by the action of inorganic acids on carbohydrates or from cellulose fibres

decayed through ageing. It is suggested that the presence of the latter humus compound in peat may be due to the decomposition of cellulose not eliminated by micro-biological activity. A humus compound of this type was isolated from a sample of Egyptian linen of the 18th Dynasty. —B.C.I.R.A.

Discoloration of Textile Fabrics. *Chemical Age*, 1926, **14**, 303.

While several micro-organisms are known to discolour cotton and wool, none have been found to have that effect on silk. Many grow on silk hosiery fabric without tendering, but *B. Uycoides* and *B. Proteus* will tender it even in the cold. Various aspergilli will grow on tin-weighted silk without damage. —F.G.P.

Surface Tension in the Textile Industry. N. T. White. *Dyer and Calico Printer*, 1926, **56**, 30-31.

Wet processes of textile treatment are more efficient if the liquors employed have a low surface tension, since they then have increased wetting-out powers. The theory of surface tension is discussed, and the surface tensions of a number of aqueous liquors such as are employed in textile processes are given. —A.J.H.

Field Plots: Mathematics. F. L. Engledow and G. U. Yule. *Empire Cotton Growing Review*, 1926, **3**, 112-146.

In making yield trials for comparing varieties or differences in treatment, of agricultural products, the area of ground under experiment should be divided up into as many small plots as can conveniently be worked, and the treatments tried as far as possible on adjacent plots, each treatment being repeated in several places. By means of arithmetical examples, the efficiencies of different arrangements of plots are compared, and a modified theory of sampling errors is developed for testing the significance of differences in yield. The effect of weather variation is also discussed, and corrections are made. The whole paper is written in elementary fashion, and assumes familiarity only with the symbols and ideas of standard deviation, variance and correlation. There is an interesting paragraph explaining the meaning of "probable error" and "standard error" as tests of significance. —B.C.I.R.A.

Alkaline-Earth Chlorides: Hydrolysis by Steam. P. L. Robinson, H. C. Smith and H. V. A. Briscoe. *J. Chem. Soc.*, 1926, **129**, 836-839.

The chlorides and bromides of calcium, strontium and barium are all hydrolysed by steam under atmospheric pressure at high temperatures, the ease of decomposition decreasing with increasing atomic weight. The lowest temperatures at which decomposition is appreciable are—Calcium chloride 425°, strontium chloride 640°, barium chloride 970°. The bromides in general are more easily hydrolysed than the chlorides. Calcium carbonate decomposes appreciably at 440° in steam. —B.C.I.R.A.

Patents

Apparatus for Measuring the Shrinkage of a Twisted Yarn. A. Branca. F.P. 591,924.

This apparatus is designed to determine the reduction resulting from a given twisting of a single yarn or of folded yarns, and comprises, at its superior part, a counter indicating the number of a turning hook to which is bound an end of the yarn, and at its inferior part a slide bar supporting a hook for the other end of the yarn and an appropriated weight. A metric or other scale is fixed on the side. —Bur. Text.

Absorption Testing Device. F. A. Sesler, U.S.P.1,561, 285 (from *Chem. Abstr.*, 1926, **20**, 111).

A device for testing the rate of absorption of liquids by fibrous sheet materials, especially adapted for testing the absorption of binders by paper or textile fabrics, has been patented. —B.C.I.R.A.

Strength Testing Machine. A. Elmendorf, Chicago, U.S.A., and R. Marx, London. E.P.248,888.

Details are given of a method for determining the strength of paper, board, fabrics, leather, &c., in which a clamped area of the sheet material is subjected to the penetrating action of a falling tool and the amount of energy absorbed in penetration is measured. A baseplate carried on tripod legs is provided with a recessed hole communicating with a spring case. The specimen of sheet material is clamped to the baseplate by a heavy annular weight. Rising from the baseplate are two vertical guide members, bridged at the top, which serve as guides for a carriage having four arms and carrying the piercing tool. The carriage may carry an additional weight. A hook member on the carriage engages in the highest position a catch which may be released by pulling a string. A spring member is adapted to be pushed along a scale. In use, the carriage is raised to the highest position and the specimen is clamped, the spring member is adjusted to its zero position on the scale and the carriage is released. After the specimen is pierced the tool engages the cap on the spring at the same time as an arm engages the spring index. The amount the index is moved corresponds with the compression of the spring, and this depends upon the energy left in the falling weight after piercing the specimen. As for any particular apparatus the potential energy of the falling weight at release is constant, the scale may be calibrated in terms of

residual energy. The index may take the form of a piston moving in a cylinder of liquid which is pushed up an indicating tube. —B.C.I.R.A.

7—BUILDING AND POWER

(F)—LIGHTING

Factories: Illumination. K. M. Reid. *Sci. Abs.*, 1926, **29B**, 198 (from *Canadian Elect. News*, 1926, **35**, 45-48).

The author discusses the advantages of good lighting in the factory, showing that the rate of production can be increased. Curves are given showing the relation between the time taken for the eye to perceive a black dot on a white ground and the illumination, and the time required for the eye to discriminate detail. These show clearly the advantage of good illumination, particularly for the astigmatic eye. An account is given of tests made under working conditions over a period of ten weeks during which time the employees were unaware that their production was being tested. During the first two weeks of the test the original artificial lighting and day lighting were used in combination, giving an average illumination of about 5 ft.-candles. A new lighting system of high grade industrial units placed at 8×10 ft. centres and about 12 ft. above the floor was introduced and during the remaining weeks the illumination was adjusted for a week to 6, 13 or 20 ft.-candles. The corresponding increases in production were 4, 8 and $12\frac{1}{2}\%$. The increased cost of the 20 ft.-candle illumination was 2·1% of the pay sheets. —B.C.I.R.A.

Incandescent Lamps: Ultra-Violet Radiation. C. Fabry. *Sci. Abstr.*, 1926, **29B**, 51 (from *Soc. Franc. Elect., Supplement to Bull.* No. 50, Oct. 1925, 17-25).

The paper gives the results of experiments on incandescent tungsten filament gas-filled lamps compared with the solar rays. The problem divides itself into two parts—(1) Study of the direct radiation of a luminous body without absorption; (2) study of the absorption exercised by the absorbing body on the various radiations and traced on the spectral curve of transmission. A figure gives the curves for violet rays from the sun and lamp. The rays emitted by the sun are very rich in radiations of feeble wave-length, even for λ less than 300 mμ, and without atmospheric absorption would be insupportable to the eyes; the same would probably apply to the tungsten lamp if its gas globe could be omitted. Curves are also given for the absorption of various kinds of glass with different transmission factors and the atmosphere. This last varies very greatly according to the position of the sun, state of the air, position of the observer, &c. The author draws conclusions concerning the constitution necessary for gas globes required to eliminate completely certain extreme radiations. —B.C.I.R.A.

Light Standard. P. Fleury. *Ann. de Physique*, 1926, **5**, 265-358.

The author describes a means of employing radiation from a black body as a standard of light intensity. The radiator used consists of a block of carbon pierced by a small opening (22 mm² or 1/100 of the total cross section) heated to about 2075K in a carbon tube furnace. This temperature can be maintained constant to within some tenths of a degree; it is adjusted with precision by determining the radiation emitted by the black body over a narrow region of the spectrum. An auxiliary black body maintained at the melting point of gold (within 0·2 of a degree) serves as a standard of monochromatic light; the ratio N of the flux emitted by the two black bodies is measured on a spectrophotometer—with the interposition of a Talbot disc—in the region of wave length 622 $\mu\mu$ (the spectral band used is defined to approximately 0·2 $\mu\mu$ by the aid of certain rays of the neon spectrum). N can be determined with a precision corresponding to a maximum error of 1·25% on the brilliancy; the radiation of the standard probably does not differ more than 0·6% from that of a perfect black body. A formula is given connecting the black body radiation between 450 and 470 $\mu\mu$ with that of standard carbon filament lamps. —B.C.I.R.A.

Photometry and Lighting. E. Haas. *Compt. Rend.*, 1926, **182**, 1176-1178.

When the uniform illumination of a surface varies over a period of time, the perception of the variations by the eye is dependent on their extent and speed of recurrence. The author measures this property of the eye, which he terms "successive differential sensitivity" to light. The apparatus is described, and consists essentially in a constant light source and a revolving toothed disc used in conjunction with a slit for obtaining periodic variation. —B.C.I.R.A.

(H)—HUMIDIFICATION

Drying Room "Humidimeter." L. Flamand. *L'Avenir Text.*, 1926, **8**, 203-209.

The apparatus, for regulating the humidity of the air of a drying room, is constructed on the wet and dry bulb principle, and comprises two similar precision thermometers bent at right angles, the graduated stems being fixed vertically and at the same height on a wooden panel fixed on the outside wall of the room. The bent portions project through the wall into the drying room atmosphere and are placed preferably in the air current exit.

The bulb of one thermometer is surrounded with fine flannel kept moist by contact with distilled water in a cup which is supplied from a glass reservoir suitably mounted on the panel. —B.C.I.R.A.

(I)—VENTILATION

Air Pollution Measuring Apparatus. J. B. C. Kershaw. *Industrial Chemist*, 1926, **2**, 153-158.

Standard apparatus and methods in use for measuring air pollution are described and some figures relating to total soot and dust and to the amount and character of the soluble constituents of air pollution are reproduced from the eleventh report of the Advisory Committee on Air Pollution. The apparatus described includes a standard soot and dust gauge, an automatic air filter and the jet and settlement dust counters. —B.C.I.R.A.

PATENTS

"Voltolised" Lubricants: Preparation. E. C. Isom. G.P.234,543, 236,294, and 185,931 (from *Oil and Gas J.*, 1925, **24**, 156, through *Chem. Abstr.*, 1926, **20**, 281).

"Voltol" is a lubricant manufactured by subjecting fatty and mineral oils to an electric glow discharge of 4,000 volts at 500 cycles. The process is carried out in a closed horizontal cylindrical steel vessel of 30 cu. m. content, under a reduced pressure of 24-26 inches of mercury with the addition of no other gas. Since the oil is held at 80°, vapours are formed and the "voltolising" is carried on in a rarified atmosphere of oil vapours. None of the properties is affected except the viscosity, but the friction reduction often amounts to 30%. "Normal voltol" is a compounded oil with a viscosity of 1,500 Saybolt at 212° F., consisting of a mixture of fatty oil with mineral oil. Uses of the lubricant include lubrication of internal combustion engines, high-pressure compressor, superheated steam cylinders, marine engines, heavily loaded ring-oiling bearings, &c. The process increases the viscosity of an oil 300% without affecting its original pour test. —B.C.I.R.A.

8—DESIGN

Mutochrome. A. B. Klein. *J. Soc. Dyers*, 1926, **42**, 121-124; and C. F. Smith, *J. Sci. Instr.*, 1926, **3**, 225-227.

The instrument enables any given design or pattern to be studied in an infinite number of colour combinations with the minimum expenditure of time and effort. A series of transparencies, each of which corresponds to one element of the design, is produced on different portions of the same photographic plate. These images are projected on to a screen through separate lenses in such a way that they register accurately. Any individual element can then be coloured at will by inserting a colour filter in front of the corresponding lens, the adjustment of an iris diaphragm controlling the brightness or depth of the colour. The standard instrument has ten lenses. —B.C.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Artificial Silk: Questions in Parliament. *Chemical Age*, 1926, **14**, 374.

Sir P. Cunliffe-Lister said that 10 Rayon factories had been started since 1st July, 1925, of which five are experimental and five producing. Another six are to be started soon. Mr. McNeil said that the net Customs revenue on imported silk and rayon between 1st July, 1925, and 31st March, 1926, was approximately £2,591,000. The fines for attempted evasion up to 28th February, 1926, amounted to £3,103. —F.G.P.

Italy's Silk Trade. *Daily Mail*, 16th July, 1926, p. 7.

Italy now claims second place in the world's output of rayon, there being 16 companies producing, with a total capital of about £11,715,000. The workpeople number about 35,000. Great Britain takes 30% of the Italian rayon. —F.G.P.

Cotton Production 1923-24: Tanganyika. *Empire Cotton Growing Review*, 1926, **3**, 61 (from *Rept. on Administration of Tanganyika Territory*, 1924, p. 47).

A table of production by districts for the years 1923-24 and 1922-23 shows a total increase of 1,700,000 lb. of lint approximately. This is the native crop, which in 1922-23 represented 42·8% of the total, and in 1923-24 represented 64·3%. —B.C.I.R.A.

Cotton Cultivation in Iraq. *Empire Cotton Growing Review*, 1926, **3**, 58.

The cotton remains remarkably free from disease, though the presence of the spotted bollworm is reported. Much irrigated cotton is being forced into premature opening by water shortage; and a dull, weak-stapled cotton is being picked. At the present state of the market, the prices paid to the growers, i.e. Rs.500 per ton for first-class cotton, are too high, and the price will probably have to be reduced. —B.C.I.R.A.

Cotton Cultivation in the Sudan. P. F. Martin. *Text. Rec.*, 1926, **43**, No. 516, pp. 86-90.

The Sudan Government has received guarantees amounting to £13,500,000 under the Trade Facilities Bill; this will be devoted chiefly to experiments on the cultivation and marketing of cotton, which will be carried out on the Sudan Plantation

Syndicate's estates. In a few months time the Gezira Plain will benefit from the Sennar Dam on the Blue Nile, and 300,000 acres will be put under cotton.

—B.C.I.R.A.

Cotton Goods: Indian Imports, 1925. *Text. Rec.*, 1926, **43**, No. 517, p. 79.

An analysis of India's imports of cotton textiles for the year 1925. Statistics show a drop in the total value of the imports as compared with 1924. This was due in part to the state of the market, but in part also to the enormously increased production of the Indian mills. The United Kingdom is still the predominant supplier of piece goods to India, but Japan, owing to greater activity more than to lower prices, is rapidly encroaching on her position. —B.C.I.R.A.

Durango Cotton Cultivation in Australia (Queensland). *Empire Cotton Growing Review*, 1926, **3**, 63-64.

Yields of Durango cotton in the Upper Burnett Settlement have reached as much as half a ton to the acre. The advantage of May ploughing, i.e., before the onset of winter, over spring ploughing (August) was shown by adjacent blocks yielding respectively 1,200 lb. seed cotton and 650 lb. to the acre. Brokers' reports on representative samples collected by the Government Cotton Classer show that the values ranged from 1¼d. to 4½d. above April American Futures. The series consisted of seven samples of Durango and one each of Lone Star and Acala; the last named, which was roller ginned, being valued at 450 points on. Up to August last, seed for 15,000 acres had been applied for, of which all, except that for 200 acres, was Durango. It is the policy of the Government to encourage the planting of better quality cotton. In the few instances where Durango was reported to have yielded poorly, the cause was apparently due to unfavourable weather conditions rather than to any inherent fault in the seed. —B.C.I.R.A.

Cotton Cultivation in Australia (Queensland). G. Evans. *Empire Cotton Growing Review*, 1926 **3**, 87-102.

The most serious handicap to cotton production in Queensland lies in the uncertain rainfall. Pink bollworm and high picking costs render ratooning unprofitable; and the abandoned pest-infected ratoon cotton on cleared scrub land now constitutes a menace to the industry. Cotton is not an unqualified success as reclamation crop, and its future lies mainly on the plough land. Growers' costs to the ginnery average 3·74d. per lb. of seed cotton. Including all expenses of sale in Liverpool a price of 15·592d. is required to meet costs per lb. of lint. Growers must therefore concentrate on at least 1⅛ to 1$\frac{3}{16}$ in cotton if cotton is to be grown at a profit. A solution must be found to the problem of picking costs, which at present amount to 2d. a lb. for seed cotton, an undue burden. Only 80 lb. a day is the picking tally, and higher yielding cottons are necessary if this cost is to be lowered. U.S.A. picking costs average ½d. to ¾d. a lb. Cotton production on the coast, owing to the prevalence of boll rot, is on the decline; and it is likely that the great majority of the cotton will be produced in the belt varying from 40 miles to 100 miles from the coast. Small acreages of cotton as a subsidiary to dairying is thought the probable line of development.

—B.C.I.R.A.

Cotton Cultivation in S. Rhodesia. G. S. Cameron. *Empire Cotton Growing Review*, 1926, **3**, 147-164.

The condition of cotton growing up to the end of the 1924-25 crop is briefly described. Ginning, which was one of the main problems, is now completely established, and enough equipment exists to gin 50,000 bales if necessary over a period of four months. Owing to rapid extension, 1924 seed supplies were inadequate, and as much as 6d. a lb. was paid for very indifferent seed. The propagation and distribution of unmixed seed is now most important, and for this purpose the Gatooma experiment station programme includes the testing of numerous strains and varieties both local and imported. Means are also being found rapidly to spread the cultivation of the best of the existing commercial stocks. —B.C.I.R.A.

Cotton: Production Statistics. J. A. Todd. *Empire Cotton Growing Review*, 1926, **3**, 165-169.

The 1924-25 world crop was only 4% less than the 1914-15 record of 27,919,000 bales; whilst the estimates for 1925-26 show an increase of 6% over the previous record. A graph clearly demonstrates the course of production since 1902-03, and shows the outstanding influence of the American crop. Separate figures from 1914-15 are given for India and Egypt, showing acreage, crop, yield, consumption, and prices. The Government acreage figures for Egypt are suspect; and an apparent recovery in yield per acre, namely, to an average over 4 kantars per feddan, is dubious. An increased production in the smaller crops from 1,154,000 bales in 1914 to 2,500,000 bales in 1925 is shown in a detailed table.

—B.C.I.R.A.

Cotton Cultivation in Iraq. Khan Sahib A. A. Soofee. *Empire Cotton Growing Review*, 1926, **3**, 171 (from *Mem.* 10 *Dept. Agric., Iraq*, May 1925).

The value of the cotton crop in a test against rice was two and a half times that of the rice for the same area, while it only used about a quarter of the water required by the latter. —B.C.I.R.A.

Cotton Cultivation in Tanganyika, 1925. *Empire Cotton Growing Review*, 1926, **3**, 173.

Though a 50% increase of seed was distributed in 1925, the crop will barely exceed the 1924 crop, which amounted to 15,000 bales of 500 lb. The season was unfavourable, and difficulty in maturing, boll rot, and insect pest attack are reported from the cotton areas. Cotton, however, does not appear to have suffered as much as food crops. —B.C.I.R.A.

Cotton Production in Nyasaland, 1923-24. *Empire Cotton Growing Review*, 1926, **3**, 59 (from *Rept. Dept. Agric., Nyasaland*, 1924).

European production of cotton was only 771 tons on 26,120 acres, a yield which leaves much room for improvement. Bollworm was less marked than previously, but much damage was done by both rot and stainers. The amount of seed cotton produced by the natives was nearly double that grown in 1923. —B.C.I.R.A.

Cotton Growing Profits in U.S.A., Egypt and India. *Int. Cotton Bull.*, 1926, **4**, 199-200.

The Washington Bureau of Agricultural Economics shows that up to July, 1925, American cotton growers have been advantaged in prices for their products to the following extent.

Year	Cotton and Cottonseed	Thirty Farm Products
1921	101	116
1922	156	124
1923	216	135
1924	211	134
1925 (July only)	186	148

In Egypt the average price of G.F. Sakel at Alexandria in 1924 was 221% of the average for 13th January, 1913-31st July, 1914, as compared with a wholesale index of 141 for other commodities, mostly agricultural. In India for July, 1925, the wholesale price of raw cotton at Calcutta was 215% of the price in July, 1914, as compared with 135% for cereals and 180% for miscellaneous food articles.

—B.C.I.R.A.

10—MISCELLANEOUS

"Service Recorder." E. Acheray. *L'Avenir Text*, 1926, 8, 157-163.

The instrument can be applied to all types of machinery, and gives an accurate record of the time during which the machine is running and the time during which it is stopped. The apparatus is arranged to be controlled by some movement due to the actual work of the machine and not by the driving mechanism, so that only useful running is recorded and no record is made when the machine is running empty. The instrument is simple and compact, and it is impossible to falsify the records. It comprises essentially clockwork mechanism which carries a disc marked off in hours sub-divided into 5 minute sections, and a freely oscillating pendulum which carries a stylet of special type requiring neither pencil nor ink.

—B.C.I.R.A.

Upper Nile Basin (including Uganda); Physiography. H. E. Hurst. *Ministry of Public Works, Egypt, Physical Department*, Paper No. 21.

The hydrology and climatology of the Upper Nile Basin, which includes practically the whole of Uganda, and parts of the Belgian Congo, Tanganyika and Kenya are dealt with. Photographs illustrating the various types of country and an excellent physiographical map on a scale of 1 in. to 32 miles approximately are reproduced. It is stated that all authorities who have studied the question are in agreement that the full utilisation of the waters of theNile for the development of irrigation in its basin will ultimately require the prevention of waste in the Sudd region, and the provision of large volumes of stored water in the Great Lakes of Central Africa. This survey considers the proposals for the construction of dams on the White Nile near its source, and the advantages of using Lake Albert as a controlled reservoir are tentatively discussed. A relatively slight work of construction on the Albert Nile might effectively serve this purpose. Recommendations for further work and observations on this problem are made. —B.C.I.R.A.

Imperial College of Tropical Agriculture: Research Programme. H. M. Leake. *Tropical Agriculture*, 1926, **3**, 86.

The report of the Imperial College of Tropical Agriculture for the Session 1924-1925 states that work on the cotton crop may be divided into several sections. Attempts are being made to evolve an Egyptian cotton with the staple of Jannovitch and suited for growth in the West Indies. There appears an opening for a plant which would have a more certain market than the Sea Island now grown. Attempts are also being made to improve the staple of the Marie Galante perennial cotton. An investigation of the effect of different water supplies on the characteristics of the lint, and genetic investigations of various characters of the cotton plant have been undertaken. The cotton stainer has received further study with special relation to variability in connection with migration. —B.C.I.R.A.

Smoke Particle: Measurement. J. S. Owens. *Analyst*, 1926, **51**, 2-18.

Methods of measuring the smoke pollution of city air are reviewed. The methods adopted by the Advisory Committee on Atmospheric Pollution are of three types—the deposit gauge, the automatic filter devised by the Committee, and the jet dust counter devised by the author. These instruments are described. —B.C.I.R.A.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(C)—Vegetable

Cotton Cutivation in S. Africa. *South African Cotton Growers' J.*, 1926, **2**, No. 8, p. 3.

South African prospects this year are regarded as good, and especially in Rhodesia, where 750 lb. seed cotton per acre is expected. In the Natal Zululand area the Lebombo Estates have abandoned cotton cultivation, as have some of the lesser growers also. —B.C.I.R.A.

Cotton Cultivation in Brazil. O. W. Willcox. *Tropical Agric.*, 1926, **3**, 70-71, 92 (from *Tea and Coffee Trade J.*).

The Brazilian Government is interesting itself in the problem of cotton growing. Several experiment stations have been established, improved seed is being distributed on a large scale, and very favourable conditions are provided for the establishment of new cotton plantations and the erection of gins. Cotton production is being concentrated in Sao Paulo, which now produces about a quarter of the total crop. There are at present 55 modern cotton mills in Sao Paulo, and within little more than 10 years Brazil's cotton imports have decreased almost to nothing. Her population is practically independent of foreign mills, except for the finer weaves, and exportation is growing.

—B.C.I.R.A.

Cotton Cultivation in South Africa (Griqualand West). F. W. Jameson. *African Cotton J.*, 1925, **1**, No. 11, p. 35.

In the irrigated farming areas of Griqualand West cotton is found to require only about half as much water as lucerne. The plant is very hardy, and the north-west hot winds blowing from the Kalahari desert do not retard its growth. From the 1924 and 1925 experiments Improved Bancroft demonstrated its superiority over the other varieties, namely, Griffin, Zululand Hybrid, Pima, Uganda, and Watt's Long Staple.

—B.C.I.R.A.

Modern Views on Cotton. A. J. Hall. *Dyer and Calico Printer*, 1926, **56**, 10-11.

A continuation of previous articles, the ash and ash alkalinity of various cottons and cottons in various stages of purification being considered in relation to their absorption of Methylene Blue. —A.J.H.

Segregation. W. Bateson, *J. Genetics*, 1926, **16**, 201-235.

This paper is the substance of an address delivered in Philadelphia in 1922, and forms a reasoned exposition of the author's views on segregation from a number of different aspects. Arguments for and against the "presence-and-absence" theory are given at some length and illustrations from rabbits, mice, peas and primulas are used in describing the nature of segregation. The author then goes on to discuss the moment at which segregation occurs, and also linkage and other aspects of the chromosome theory. Chimaeras are discussed at considerable length, as are also irregular mosaics in plants and animals.

—L.I.R.A.

Cotton Cultivation in Ceylon. C. R. Hilson and G. Habard. *Text. Merc.*, 1926, **74**, 410-411.

A tour of the Southern, North Central, and Eastern Provinces has led the author to an encouraging view of the possibilities of cotton cultivation in Ceylon. Small holdings of a minimum acreage of 20-25 acres are recommended, and a four course rotation of cotton, cereal and legumes, the particular crops to be determined by experiment. Plant breeding work directed towards the maintenance of a supply of pure Cambodia and Durango seed should be carried on at the Ambalantota Government Experimental Station. The coming cotton crop covers not more than 1,000-1,200 acres, which should yield some 4 cwt. of seed cotton per acre. The crop has been remarkably free from pests and diseases. This report states that Hatagala and Welipatanwila along the main coast road, and Talawa and Middeniya in the interior area, are the four most promising centres for cotton growing and for crop rotation investigation work. Some of the best cotton land is to be found at Dabarella. —B.C.I.R.A.

"Pilot" Cotton Seed Planting Machine. Ransomes, Sims and Jefferies, Limited. *Text. Rec.*, 1926, **43**, No. 516, 94.

The machine is made for planting rows at varying distances between 2 ft. 6 in. and 4 ft. apart. Double foot levers are provided for assisting in the control of the machine. When lifting the furrow openers from the ground a simple device automatically stops the planting mechanism, the operation being reversed when the openers are again lowered. For continuous sowing, the bottom of the seed hopper is provided with an agitating star wheel, which regularly carries the seed to a continuous picker wheel revolving in the opposite direction immediately beneath it. Around the picker wheel is a spring seed controller which, whilst ensuring a constant flow of seeds being planted singly, prevents

the possibility of seed, when covered with much lint, being drawn through and sown in bunches. By means of a sliding shutter, which is adjustable from the outside, the flow of the seed can be conveniently regulated. The "Pilot" apparatus is made as a one or two sow machine, with or without fertiliser attachment. —B.C.I.R.A.

Rhea Fibre: Properties and Application. H. M. Hill. *Amer. Dyestuff Rep.*, 1926, **15**, 251-258.

A general account. Rhea fibre was extensively used by the ancient Egyptians and was probably a native of Egypt, whence it was transplanted to India and China. Hand-retting is still practised in Egypt and China. Rhea is derived from the third class of stingless nettle, *Boehmeria Nivea*, and seems to be exceptionally well suited for the production of medium and fine grade yarns and fabrics. It is completely resistant to mildew. The surface of the fibre has nubs or rings at regular intervals and on this account it cards and mixes with wool extremely well; 25% of Rhea fibre mixed with wool increases the strength of the wool by about 40%. Rhea fibre is said to have about 7½ times the strength of cotton and one-half the elasticity. It resists damp, possesses valuable hygienic properties, takes the same dyes as cotton, has excellent heat-resisting and wearing qualities and is absorbent and non-shrinking. The Rheabat Corporation in America and, in Britain, the Nivea Corporation are handling Rhea fibre as a commercial proposition. —B.C.I.R.A.

Cotton Hairs: Classification. W. M. Mebane and F. C. Vilbrandt. *Amer. Dyestuffs Rep.*, 1926, **15**, 279-282.

The appearance of cotton hairs in green, medium, and ripe cotton and in after-frost cotton from open and semi-open bolls is illustrated; and the relation between the growth condition at the time of picking and the microscopic appearance of the hair is shown. From this the value of the hair for textile purposes can be judged. Weight ratios and the "rag doll" germination test also give an indication of the growth condition of the hair. The growth condition makes itself evident in finished fabrics both in dyeing and chemical treatment. —B.C.I.R.A.

Flax Cultivation: Australia's Opportunity. *Bot. Abs.*, 1926, **15**, 1 (from *J. Dept. Agric. Western Australia*, 1925, 2nd series, **2**, p. 91).

Attention is drawn to the high prices paid for flax fibre and to the high quality of the product that probably can be grown, as evidenced by that produced on a small plot at Eden, New South Wales.
—L.I.R.A.

Cotton Cultivation in South Africa. P. Koch. *Bot. Abs.*, 1926, **15**, 14 (from *South African Fruit Grower*, 1924, **9**, 233-239).

A general account. Cotton can be grown on nearly every type of soil on which maize grows, providing it is deep and well drained. The cotton plant is not subject to the attack of the witchweed. —B.C.I.R.A.

Cotton Cultivation in Porto Rico. J. F. Legrand. *Bot. Abstr.*, 1926, **15**, 15 (from *Rev. Agric. Puerto Rico*, 1923, **10**, 35-40).

General directions for growing Sea Island cotton under Puerto Rican conditions.
—B.C.I.R.A.

Pseudo-winter Hemp by Natural Conditions; A Remarkable Case of Selection of a——. N. I. Pushkarev. *Bot. Abs.*, 1926, **15**, 21 (from *Rostov* (Don), 1924, 23 pages).

By sowing a cultivated spring variety of hemp in fall, and by repeating the experiment with the seed gathered from the plants withstanding the winter, a pseudo-winter hemp was obtained. The latter was successfully sown in fall, while the sowings obtained from seed of the common spring hemp were almost entirely killed. Pseudo-hemp occupies an intermediate position between cultivated hemp (*Cannabinus sativa*) and weed hemp (*Cannabinus ruderalis*). —L.I.R.A.

Linseed. A. N. Sutulov. *Bot. Abs.*, 1926, **15**, 25 (*Moscow*, 1923, 164 pages).

This paper is part of a monograph on linseed planned by the author. The first two parts treat of the processes of ripening and germinating, the third of weed admixtures.
—L.I.R.A.

Cotton Cultivation in Porto Rico. J. M. V. Colon. *Bot. Abs.*, 1926, **15**, 27 (from *Rev. Agric. Puerto Rico*, 1925, **14**, 325-330).

An experimental planting of Sea Island cotton was made in the semi-arid region of the south coast of Puerto Rico. In spite of insect attacks an excellent yield was obtained. —B.C.I.R.A.

Cotton Plant: Natural Hybridisation. L. Dekaprelevich. *Bot. Abs.*, 1926, **15**, 81 (from *Sci. Papers Appl. Sect. Tiflis Bot. Gard.*, 1924, **3**, 90-98).

In the event of mixed planting of cotton, the quantity of natural hybrids in the second generation reaches 7%. By planting the two forms of cotton in alternate rows it was found that natural hybridisation amounted to 1-5%. The insects which aid natural hybridisation are mainly *Anthrena dubitata*, *Halictus albipes*, *H. sexcinctus*, and *Apis melifica*.
—B.C.I.R.A.

Lupine Fibres; The Microscopy of——. J. Weese. *Bot. Abs.*, 1926, **15**, 114 (*Mitt. Tech. Mikrosk. Lab. Techn. Hochschule Wien* 1, 3-16, 1924).

The paper deals with the microscopy of the bast fibres of some species of lupine cultivated in Austria, since the works of T. F. Hanausek and R. Schwede concerning these fibres do not agree on important points. The idea of using lupines as fibre-supplying plants is not new. The fibres of *Lupinus albus* have been used for more than 100 years in Southern countries for ropes and cordage and in the manufacture of paper. The literature contains records of such usage. The author studied not only the species of lupine examined by Hanausek, but also a number of other cultivated species, in order to clear up the apparent contradictions concerning the structure of the fibres. —L.I.R.A.

Manila Hemp; Preliminary Note on——. R. O. Bishop and E. A. Curtler. *Bot. Abs.*, 1926, **15**, 480 (from *Malayan Agric. J.*, 1925, **13**, pp. 125-138).

A general account of the cultivation of *Musa textilis* is given with particulars of fibre extraction. Notes on locally grown plants and fibre and a comparison between local fibre and that from the Philippines are given. Local culture has not hitherto been very successful. —L.I.R.A.

White Flowered Flax. J. C. Dorst. *Bot. Abs.*, 1925, **14**, 1247-1248 (*Landbouwk Tijdschr.*, 1925, **37**, 81-93).

Formerly, blue flowered flax was much grown in the Netherlands, but it is being replaced by a white flowering variety, about 60% of the flax area being devoted to this type, which originated in the Province of Friesland. The writer discusses the occurrence of this variety in various parts of the Netherlands, the appearance of the crop while in flower, and the comparative properties of the two varieties. The white flowering kind is said to be more resistant to injurious influences. —L.I.R.A.

Cotton Cultivation in Cyprus. J. D. Shepherd. *Bot. Abs.*, 1925, **14**, 1260 (from *Cyprus Agric. J.*, 1925, **20**, 15-20).

In practice the cultivation of cotton in Cyprus compares very favourably with that of Egypt. Ploughing should precede the rains and should be deep. The seed should be planted on the south side of the ridge facing the longer sun period. It is customary to plant cotton in hills from 30 to 35 cms apart with rows 70 cms apart. The cotton boll worm is said now to be present in large numbers in Cyprus cotton fields. Every effort is made to increase early maturity of cotton by sowing seed in February instead of March and by limiting irrigation in July and August. —B.C.I.R.A.

Cotton Planting in W. Australia. I. Thomas *Bot. Abs.*, 1925, **14**, 1263 (from *J. Dept. Agric. Western Australia*, 1924, 2nd Series, **1**, 328-329).

Experiments with cotton at the Chapman Experiment Farm are described. The experiment was planned to determine the earliest date at which cotton could be sown, the advantage of early sowing being the presence of more moisture than is normally available to a later sown crop. Sowing prior to September was unsuccessful because the ground was too cold to permit germination, although there was abundant moisture at this time. By September the ground was warm enough to permit germination but the air temperature was too cold for vigorous growth. Later, the temperature was high enough for satisfactory growth but the moisture was deficient. —B.C.I.R.A.

Cotton Cultivation in China. C. C. Chen. *Bot. Abs.*, 1925, **14**, 1323 (from *Science Publ. Chinese Sci. Soc.*, 1925, **9**, 1373-1381, and *China Weekly Rev.*, 1925, **31**, 221-222).

The author discusses plant improvement as the most important economic problem of China and relates the early history of plant breeding in China. A description is given of the plant breeding farm of the Peking University at Haitien, Peking, organised under the author's supervision. It is hoped to develop a disease-resistant variety of each native crop plant, and plans and methods for these breeding projects are given. —B.C.I.R.A.

Cotton Plant Diseases in Rhodesia: Occurrence. F. Eyles. *Bot. Abs.*, 1925, **14**, 1416 (from *Rhodesia Agric. J.*, 1924, **21**, 592-595).

Of the 24 parasitic diseases of the cotton plant, only six have so far been recorded from Southern Rhodesia. These include angular leaf spot (*Pseudomonas malvacearum*), anthracnose, a boll rot caused by *Bacillus gossypini*, a boll rot probably caused by some new bacterial organism, black rust, and stem rot. A popular description is given of each of the diseases and methods of control. Mention is also made of the physiological complaints known as boll shedding and yellows. —B.C.I.R.A.

Cotton Acclimatisation in China (Nanking). J. B. Griffing. *Exp. Sta. Rec.*, 1925, **52**, 734 (from *Univ. Nanking Agric. Forest. Serv.*, 1923, **1**, 45).

Experiments have demonstrated the efficacy of roguing and selection in overcoming the degenerative tendencies resulting from change of environment. As judged by lint length, size of seed, and lint index the quality of the crop at the end of three years' work seemed superior to that of the first year. Breaking up of variety type into diverse forms was noted in all imported stocks, even in such pure strains as College No. 1. —B.C.I.R.A.

Fibre Production in Bast Fibre Plants; Influence of Nutrition on——. W. Kruger, G. Wimmer, and G. Bredemann. *Exp. Sta. Rec.*, 1925, **53**, 235 (from *Ernähr. Pflanze*, 1923, **19**, Nos. 13-14, pp. 89, 90).

Soil type and nutrition affected fibre production in the nettle (*Urtica dioica*) in earlier tests. In the experiments here reported, enhanced fibre content followed increases in the potassium application, whereas increasing nitrogen and phosphorus seemed of rather doubtful value. The separation of the fibre from the stalks and the fibre colour, after separation (snow-white to brownish-yellow) which are closely related, were likewise influenced by potassium. The most favourable ratio of nitrogen to potash in the fertiliser was 1: 2·5. —L.I.R.A.

Soils, Notes on the Determination of the Acidity of, by various Methods, namely, the Hydrogen Ion Concentration, Truog's Test (Sulphide of Zinc), and Comber's Reagent (Potassium Thiocyanate). R. Marloth. *Exp. Sta. Rec.*, 1925, **53**, 610 (*S. African J. Sci.*, 1924, **21**, pp. 270-4).

In the author's experience in the analysis of South African soils of low humus content, the Comber method of determining does not give reliable results. One of the sources of error in this determination is thought to be the moisture content of the soil. The presence of even a small amount of moisture reduced the intensity of the colour reaction. Moreover, some soils with the same *p*H values gave negative results and others positive with the Comber reagent. The Truog test is recommended as convenient and sufficiently accurate for the farmer, and H-ion concentration determinations either electrometrically or colorimetrically for the chemist with a laboratory at his disposal. —L.I.R.A.

Egyptian Cotton Leaf Tissue Fluids: Properties. J. A. Harris. *J. Agric. Res.*, 1925, **31**, 1027-1033.

An investigation of the leaf tissue fluids of five further varieties of Egyptian cotton was undertaken to ascertain whether all Egyptian varieties differ from Upland varieties or whether in this respect Pima stands alone. The results show that while the Egyptian varieties differ among themselves all the varieties considered have a higher osmotic concentration and specific electrical conductivity than the Upland with which they have been compared. The two types apparently do not differ in the ratio of the electrical conductivity to freezing point depression. All the Egyptian forms have a higher chlorine and a lower sulphate content than the Upland types. Differences between individual Egyptian and individual Upland types are under investigation. —B.C.I.R.A.

Cotton Stainer in U.S.A. (Texas): Life History. T. C. Barber. *J. Agric. Res.*, 1925, **31**, 1137-1147.

Dysdercus obscuratus has been found in cotton fields in Texas. It occurs from Central America along the Gulf Coast to the lower Rio Grande Valley of Texas, the area of infestation probably being extended by flight. The species feeds on *Sida carpinifolia*, *Ambrosia artemisiæfolia* and *elatior* and *Verbesina encelioides*. The eggs are deposited usually under the surface of the ground. The incubation period is about five days in midsummer. The nymph has five stages. In the Rio Grande Valley the average period of development from egg deposition to adult was found to be 32 days in midsummer, 55 days in autumn, and 87-108 days in winter. The adults are found commonly in groups on the plants on which they feed; the groups move from plant to plant. —B.C.I.R.A.

Cotton Root Rot Control in Texas. H. C. McNamara. *J. Agric. Research*, 1926, **32**, 17-24.

Whilst not conclusive, the results of preliminary experiments on the possibility of controlling root-rot by a one season or two seasons clean fallow, indicate that an absolutely clean fallow may prove an efficient means of control. —B.C.I.R.A.

Cotton Leaf Tissue Fluids: Properties. J. A. Harris. *J. Agric. Res.*, 1926, **32**, 605-647.

The relationship between the concentration of the soil solution and the physico-chemical properties (e.g., osmotic pressure, electrical conductivity, freezing point depression, &c.) of the leaf-tissue fluids of Egyptian and Upland cotton has been further studied on the lines of previous work. It is shown how physiological measurements may be carried out in the field, and the suggestion is made that the work will make it possible in the future to predict more certainly the character of the crop which would be produced by a field of given characteristics in a normal year. —B.C.I.R.A.

Nitrogen Supply on the Ratios between the Tops and Roots in Flax; The Effect of Varying the——. T. W. Turner. *Soil Sci.*, 1926, **21**, 303-304.

An attempt was made to determine the effect on the ratio of the tops to roots of flax, of varying the nitrogen supply. Earlier experiments had shown that flax was much less responsive than barley and corn in this respect, so tests were made upon flax plants grown in nutrient solutions of three different nitrate contents—"low," "medium," and "high." The cultures were harvested at three different periods, the figures for the longest period showing the greatest differences. The

author considers that the increase in the ratio of tops to roots with increasing supply of nitrogen is insignificant, although it may be mentioned that the value with the high nitrate concentration is 16% higher than that with the low nitrate concentration. On account of the differences being much smaller than those obtained with barley, the nitrogen content of the tops and roots of both sets of plants was determined. The increase in amount of nitrogen in the tops as a result of the increased supply of nitrogen was also found to be smaller for flax than for barley. The author considers that these results may be explained on the ground that in the case of barley additional supplies of nitrogen cause greater growth of the tops, which increases the use of carbohydrates in that region, whereas, "the mechanism seems to be different with flax." —L.I.R.A.

Hemp in Germany. O. Heuser. *Exp. Sta. Rec.*, 1925, **53**, 235 (from *Der deutsche Hanf.*, 1924, Leipzig, 92 pages).

Endeavouring to present recent observations and results of experiments with hemp, the book traces the developments of hemp culture in Germany; describes the plant, varieties, structure of the stalk, and the fruit; outlines environmental and cultural requirements, harvesting, breeding, and retting practices, and handling of the fibre. The economic phases of the industry are discussed and a bibliography on hemp is appended. —L.I.R.A.

American and Mexican Upland Cottons: Taxonomy. F. L. Lewton. *Exp. Sta. Rec.*, 1925, **53**, 337 (from *J. Wash. Acad. Sci.*, 1925, **15**, 65-71).

Review of early publications suggested that neither *Gossypium mexicanum* nor *Gossypium siamese* is a suitable name for American Upland cotton. For more than a century "Siam cotton" was a general name given to several species or varieties of West Indian cottons having tawny or brownish lint and to occasional white forms of these. No valid evidence seems to have been brought forward to indicate an Asiatic origin for American Upland cotton. —B.C.I.R.A.

Sex Reversal in Winter-grown Hemp; The Influence of the Substratum on the Percentage of——. J. H. Schaffner. *Bot. Abs.*, 1926, **15**, 403 (from *Ohio J. Sci.*, 1925, **25**, 172-176).

Experiments carried on to control the percentage of sex reversal by controlling the length of the daily illumination period indicated that the substratum might be a factor in reversal in association with the light period. Hemp grown in pure quartz sand supplied with nutrient solution decidedly deficient in nitrogen shows that, in spite of high mortality, the substratum has a marked influence in preventing sex reversal when a suitable light period is maintained. Instead of an expected average reversal of about 90% for the staminate plants and about 83% for the carpellate plants, the sand plants showed only 33% reversal of staminate individuals and no carpellate individuals, the entire absence of reversal in the carpellate plants probably being due to great mortality soon after bloom began. With well manured soil or even well rotted pure manure, the percentage of sex reversal in any experiment is very close to expectation. Although a primary cause of sex reversal in hemp is the relative length of daylight and darkness, the percentage is dependent on and can only be attained with, suitable substratum and proper maturity. —L.I.R.A.

Cotton Seed: Effect of Heat. M. E. Woodbridge and R. E. McDonald. *Bot. Abs.*, 1926, **15**, 367 (from *Proc. Assoc. Offic. Seed Anal.*, N. America, 1921, 97-100).

Extensive experiments to determine the safety zone to which cotton seed might be heated to kill the pink bollworm without injuring the germination of the seed showed that cotton seed possesses great resistance to heat. With dry heat on dry seed the point of injury came between 74° and 83° C. for short exposures, and for two and three hour periods between 70° and 74° C. The germinative power of the seed decreased as the temperatures and periods of exposure were increased, also, the margin between the thermal death point of the pink bollworm and the temperature at which the viability of cotton seed became injured is large enough to be safe and to make sterilisation of seed by heating a practical proposition. —B.C.I.R.A.

Abnormal Cotton Seed. S. G. Lehmann. *Bot. Zentr.*, 1926, **149**, 254 (from *J. Elisha Mitchell Sci. Soc.*, 1925, **41**, 138-140).

A case of a seed with the embryo lying in reverse position was observed. In germination the hypocotyl and root-tip must rotate through 180°. Another seed possessed two embryos; only one, however, attained full development. Both embryos may have been derived from cells of the embryo sac. —B.C.I.R.A.

"Seedling" Method, Neubauer's; for Determining Manurial Requirements of Soils. E. Gunther. *Brit. Chem. Abs.*, 1926, **45**, B250 (from *Z. Pflanz. Dung.*, 1926, B.5, 32-6).

Critical experiments on Neubauer's method for determining the phosphoric acid and potassium requirements of soils show that considerable variations in the light intensity during growth of the seedlings affect the percentage of nutrients absorbed to a small extent only. Similarly, the absorption of nutrients by the seedlings is almost unaffected by changing the *p*H of a soil from an initial value of 5·0 to 6·5 and

8·0 by addition of calcium carbonate. Under normal conditions, both light intensity and soil reaction can be neglected in carrying out the test. —L.I.R.A.

Cotton Cultivation in East Africa. B. Wunder. *Bot. Abs.*, 1925, **14**, 1265 (from *Tropenpflanzer*, 1923, **26**, 111-118).

Conditions of soil and climate in various parts of the former German East Africa are described in relation to cotton growing. The Upland types have proved to be better than the Sea Island types. Tables are given as to production, length of stems and fibres, &c., of various strains of cotton. —B.C.I.R.A.

Cotton Cultivation in the Cameroons. —. Wolff. *Bot. Abs.*, 1925, **14**, 1277 (from *Tropenpflanzer*, 1923, **26**, 38-49).

Agriculturally, Cameroons is divided into the coastal land, high elevated land of 1,000 m. above sea-level, and the Central African plateau. The agricultural experiment stations in Victoria, Kuti, and Pittoa, the school for natives, and other institutions are described. Meteorological data were carefully recorded as being considered of much value for estimating the proper time for sowing and harvesting the various crops. An outline of experiments with cotton is given. —B.C.I.R.A.

Cotton Cultivation in Brazil. A. Grieder. *Bot. Abs.*, 1925, **14**, 1249 (from *Tropenpflanzer*, 1922, **25**, 176-183).

A description is given of cotton raising in various parts of Brazil, especially in the State of Sao Paulo. A table is presented showing cotton production over ten years in ten States. Sao Paulo produced 11,261 tons in 1920. This State is not suitable for growing long staple cotton on account of the climate, but medium staple of the Upland and Egyptian types is produced. The soil is ploughed twice and harrowed three times. Seed is first disinfected for one hour in water at 55° C., followed by a sulphur bath, 100 kg. of dry seed being treated per 5 kg. of sulphur. Twenty-five to 30 thousand kilograms of stable manure per hectare are used. Velvet beans, cow peas, lupines and guardu (*Cajanus indicus*) are used as green manure. Data on the use of chemical fertilisers are given. Several areas where coffee is grown and which are not free from frost, also poor meadows where few cattle are kept, could be put into cotton fields. Plants are in rows 1 m. apart, with 4-6 plants to a hill. From 15 to 24 kg. of seed are used per hectare. Treatment and harvesting is the same as in other countries. —B.C.I.R.A.

Cotton Hair: Swelling in Cuprammonium Solution. B. Vlcek. *Melliand's Textilber.*, 1926, **7**, 361-364.

The typical bead formation shown by cotton hairs on treatment with cuprammonium solution has been studied in relation to convolution of the hairs. In many instances agreement was found between the number of convolutions and the number of beads formed, but, although it could be assumed that the chief cause of bead formation lay in the convolutions, the exceptions were too many to allow a definite relation to be stipulated. A number of photomicrographs are reproduced and explained. Bead formation is due to splitting and contraction of the cuticle, which constricts the swollen cellulose at intervals. By the action of a concentrated solution on fine hairs having a large number of convolutions the cuticle splits along the hair and winds round the swollen cell tissue. This was especially noticeable in Egyptian cotton. In general, in hairs having a smaller number of convolutions and a stronger cuticle the cuticle splits round the hair and contracts, forming narrow rings. Some subsidiary observations are also recorded. —B.C.I.R.A.

Plant Tissue: Staining. P. Fourment and H. Roques. *Chem. Zentr.*, 1926, **i**, 2938 (from *Bull. soc. pharm. Bordeaux*, 1926, **64**, 22-27).

A stain which gives a yellow to orange colour with lignin, skeletal, and cuticle substances, cork substance, pectins, gum, and mucilage is prepared by boiling 1 gram of benzidine in 10 c.c. of acetic acid and 30 c.c. of water and diluting to 50 c.c. The colours are soluble in alcohol and insoluble in water and glycerol. Stained preparations are stable for a long time. The reaction is traced to the formation of a chemical compound between the pentosans and benzidine. Cellulose constituents can be separately detected by staining with a solution of Methylene Blue, 1 : 1000, a saturated solution of benzoazurine, hæmatoxylin, &c. —B.C.I.R.A.

Cotton Manuring in U.S.A. (Arkansas). M. Nelson and W. H. Sachs. *Exp. Sta. Rec.*, 1925, **53**, 435 (from *Arkansas Sta. Bul.*, No. 195, 1925, 3-12).

In co-operative fertiliser experiments with cotton carried on in Arkansas during 1924, nitrogen and potash gave unusually good results, due largely to the dry climatic conditions and light boll-weevil infestation. Whilst nitrogen is the limiting element in the State as a whole with cotton, its best returns will rarely be had unless it is used with phosphoric acid and potash. Basic fertiliser recommendations for cotton on Coastal Plain soil are 400 lb. of 10-4-4 fertiliser per acre, on hill soil 400 lb. of 12-4-4, and for lowland soils of medium to lower fertility 400 lb. of 10-4-2 fertiliser. On the heavy soils of the lowland section, from 100 to 150 lb. of sodium nitrate alone may be used. Results obtained from the use of manure should encourage its better preservation. —B.C.I.R.A.

Cotton Cultivation in Georgia. R. R. Childs. *Bot. Abs.*, 1925, **14**, 1323 (from *Georgia State Coll. Agric. Bull.*, 1923, No. 288, 1-12).

Complaint has been made by the cotton trade that the staple of Georgia cotton (*Gossypium hirsutum*) has deteriorated. North Georgia has always had the reputation of producing cotton of high quality and good staple and it is recommended, in order that this reputation may be maintained, that the growers study the source of their cotton seed, so as to obtain the best cotton of desired grades and staple lengths. It is suggested that growers should not consider so much the percentage of lint produced by a variety as the length of the staple. It is recommended that in selecting seed, growers should secure it from plants showing high yields and good quality and community seed production is suggested as a profitable step.

—B.C.I.R.A.

Cotton Boll: Setting. A. F. Kidder and others. *Exp. Sta. Rec.*, 1925, **53**, 528 (from *Louisiana Sta. Rept.*, 1924, pp. 12, &c.).

Boll studies at the Louisiana Experiment Station gave indications of the importance of protecting boll setting while blooming is increasing to its maximum, and that weevil control after this maximum is reached is relatively less important so far as maturity of the crop is concerned. The rainfall recorded did not seem to affect boll setting injuriously. Plants spaced 8-12 inches apart averaged 30 or more bolls per row foot, whereas those spaced 20 to 30 inches apart produced only 11 bolls per row foot. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (Mississippi). C. B. Anders. *Exp. Sta. Rec.*, 1925, **53**, 332 (from *Mississippi Sta. Bul.*, 1924, No. 224, 3-12.)

Cotton variety trials during four years recommend for hill land Mississippi Station Trice, Willis, Cleveland 54, Acala, and Miller, and for bottom and rich hill land Delfos, Lone Star 65, Mississippi Station Trice, Acala, and Miller. A mixture of 300 lb. of acid phosphates, 200 of sodium nitrate and 100 of kainite has been outstanding in all fertiliser tests with cotton and is advised for the section.

—B.C.I.R.A.

Delfos Cotton. *Mississippi Agric. Exp. Sta. Circ.*, 32; June 1924.

"Delfos"—from Del(ta) and Fos(ter)—is used as a variety name for certain strains of "Foster" selected at the Delta Branch Station, Stoneville, Mississippi. "Foster" originated from a cross between "Triumph" and "Sunflower," in 1904 at Terrell, Texas. The "Triumph" parent was developed by A. D. Mebane, of Lockhart, Texas, and belongs to the big boll group; whilst "Sunflower" is a long staple variety. The object in hybridising "Triumph" and "Sunflower" was to obtain a medium long staple cotton early enough to give a profitable yield under boll weevil conditions. First generation hybrids were grown in 1905 and individual plant selections were made. The new hybrid received the name Foster in 1909, and seed was distributed each year until 1914, when the absence of uniformity led the Department of Agriculture to discontinue its distribution. From a small field of Foster many selections were made by E. C. Ewing in 1911; of these Foster 120 gave the best results, though it in turn was discontinued in 1919. However, single plant selections in 1916 from Foster 120 looked promising, and two of them, namely, Delfos 6102 and Delfos 631 remain. These strains are very distinct in habit, earliness, lint length and yield. The former with slightly shorter staple ($1\frac{1}{8}$—$1\frac{3}{16}$, *cf.* $1\frac{3}{16}$—$1\frac{1}{4}$) is earlier and more prolific. Delfos 6102 compared very favourably in the 22 inter-variety tests of 1922, in which its money value rank per acre averaged 3·5 as compared with the highest average rank among others of 5·1. Botanical characters and yield statistics are given in detail. —B.C.I.R.A.

Express Cotton. E. C. Ewing. *Mississippi Agric. Exp. Sta. Circ.*, "Express" Cotton; January 1915.

The original strain selected by D. Shoemaker in 1904, from a mixed field of so-called "Bohemian" showed remarkable earliness for a long staple Upland cotton and was therefore called "Express." It was not successful in the State in which it was originated, namely Texas, owing to a number of defects. Almost throughout Texas, and especially in the block prairie lands, a big bolled, storm-proof, vigorous, drought resistant type of cotton with a high lint percentage is preferred, and these qualities are more or less lacking in Express. Besides, neither the greater length of lint nor the extreme earliness of Express cotton was an especially valuable quality in Texas. On the contrary, these qualities are very desirable in the Mississippi Delta and the defects which proved a handicap in Texas are not so objectionable in the Delta. With the arrival of the boll weevil in the Delta, 1909-1910, the advantages of the Express variety became of great value; and from then onwards until 1915 (the date of this publication) the growth of Express increased rapidly. The staple is graded as selected $1\frac{1}{8}$ or as commercial $1\frac{3}{16}$, and it has a strong bodied, tough, even staple. "Express" is only suitable for the soils of mean strength. Excessive soil richness leads to the breaking of the slender branches during the fruiting period; and the big bolled, vigorous and longer growing varieties are more suitable for thin droughty soils that are subject to rust. "Express" is noteworthy for its very low ginning outturn, being less than 28% in practice. —B.C.I.R.A.

Cotton Hair: Diameter, Strength, and Lint Index Correlations. R. Y. Winters. *Exp. Sta., Rec.* 1925, **53**, 736 (from *North Carolina Sta. Rpt.*, 1924, 31-34, 37, 38).

In investigations in North Carolina, acid delinted seed germinated first, those rolled in ashes second, normal seed third, and seed treated with sodium nitrate last. The treatments ranked in the same order in regard to number of open bolls per acre and yield of seed cotton per acre. Considerable differences were found in the average diameters and breaking loads of hairs from Cleveland, Mexican Big Boll, King, Cook, and Rowden cottons grown under the same conditions. Diameter and breaking load are directly related and Mexican Big Boll gave the highest and Cleveland the lowest values. The correlation between diameter and breaking load for all varieties was $r = +0{\cdot}623 \pm 0{\cdot}013$. As the density of hairs on the seed coat increases, hair diameter, lint index, and percentage of lint increase and hair length and weight of seed decrease. Increase in length is associated with increased lint percentage and decreased diameter. The correlation between length and diameter is $-0{\cdot}02929 \pm 0{\cdot}0356$, and between hair length and lint percentage is $0{\cdot}265 \pm 0{\cdot}03621$. Increase in size of seed is slightly associated with greater hair length, $r = \pm 0{\cdot}11303 \pm 0{\cdot}03845$. Increased density of hairs on the seed coat is definitely associated with an increased number of convolutions per inch and increased hair length is associated with a decrease in the number of convolutions per inch. In halved hairs, the end attached to the seed was found to have the smaller number of convolutions per inch. —B.C.I.R.A.

Henequen Fibre in Yucatan and Campeche; Production of——. H. T. Edwards. *Bot. Abs.*, 1926, **15**, 482 (from *U.S. Dept. Agric. Dept. Bull.*, 1278, 1924).

Henequen fibre constitutes the main source of supply of the raw material used for the manufacture of binder twine. Practically all the henequen fibre imported into the U.S.A. is obtained from Yucatan and Campeche. Plantation organisation and management in Yucatan and the conditions under which henequen fibre is produced are discussed. —L.I.R.A.

(D)—Artificial

Cellulose Acetate Silk; General Properties of——. C. E. Mullin. *Text. Col.*, 1926, **48**, 459-462.

A collection of data relating to the moisture absorption, bursting and tensile strengths of dry and wet yarns and fabrics, resistance to alkalis, acids, and bacterial attack of cellulose acetate silks (Lustron and Celanese). —A.J.H.

Artificial Silk: Properties. M. G. Luft. *Text. World*, 1926, **69**, 319-321.

A general article showing how the various physical and chemical properties of artificial silk are valuable in particular commercial applications. —B.C.I.R.A.

Viscose: Laboratory Preparation. E. H. Morse. *Ind. and Eng. Chem.*, 1926, **18**, 398-400.

Directions are given for the preparation of viscose from sulphite cellulose in the laboratory. The product should be essentially the same as the commerical product. —B.C.I.R.A.

Viscose Sols and Silk: Plasticity. C. S. Venable. *J. Phys. Chem.*, 1925, **29**, 1239-1243.

Curves are given illustrating the effect of humidity on the plasticity of viscose silk. Viscose solutions of concentrations between 7 and 9% follow closely the laws of true solutions; their viscosities decrease with increasing temperature and fall to a minimum on ageing. —B.C.I.R.A.

Nitrocellulose: Solubility and Viscosity. J. W. McBain, C. E. Harvey, and L. E. Smith. *J. Phys. Chem.*, 1926, **30**, 312-352.

A detailed study is presented of the factors affecting the viscosity of nitrocellulose in various solvents with a view to testing the suggestion of H. Schwarz that comparative fluidity is a criterion of solvent power. The authors conclude that the fundamental fact operative in the behaviour of solvents and nitrocellulose is direct combination between solvent and suitable complementary chemical groups in the nitrocellulose. The apparent viscosity of the solutions is almost entirely due to the presence of loose ramifying aggregates of colloidal particles by local and specific bonds of residual affinity of different kinds and degree. The best solvents are those which most effectively combine with these bonds and by themselves satisfying the residual affinities dismember the aggregates. This explains why mixtures of solvents and even diluents affording a variety of suitable chemical groups are more efficient than a single solvent. Recoupling may take place when the proper points on the chemical particles are deprived of their chemical complements, for example through the action of a diluent. The viscosity of a nitrocellulose may in some cases be increased in this way. In the transformation from a sol to a solid if the recoupling takes place without appreciable segregation, transparency is not affected. In this way coherent films and lacquers are produced. —B.C.I.R.A.

Cellulose and Mercerised Cellulose: X-ray Structure; Cellulose Derivatives and Regenerated Cellulose: Magnetic and Dielectric Properties. R. O. Herzog. *Phys. Rev.*, 1926, **27**, 457-469.

The results of the Röntgen spectrographic investigation of cellulose are recorded and a comparison of the observed values with those calculated from the quadratic equation for rhombic symmetry, assuming the unit-cell to consist of four $C_6H_{10}O_5$ groups shows that these conditions are in better agreement with the experimental data than any other assumption. The point-diagram of mercerised cellulose differs from that of the original cellulose, the difference being more pronounced the more complete the mercerisation and especially where the hairs are mercerised under tension. With hairs mercerised without tension distortion of the particles soon occurs and the interference points degenerate into indistinct arcs. It is possible to follow the progress of mercerisation by X-ray spectrography. The quadratic equation for mercerised cellulose is given. A comparison of the dimensions of the unit-cells of the untreated and mercerised cellulose shows that the distance along the direction of the hair has diminished from 10·22 to 9·88 Å.U., a contraction of 3% along the direction of the hair. The horizontal dimensions increase from 8·60 to 8·88 and from 7·78 to 8·05 Å.U. The dimensions of crystallites of natural cellulose fibres have been determined. Magnetic, dielectric, and optical measurements on ramie, cuprammonium silk, two viscose silks, and two stretched viscose films show that the behaviour of bast fibres in both the magnetic and electric field runs completely parallel to the results of optical measurements and X-ray investigations. The X-ray investigation of cellulose nitrate and cellulose acetate indicates that the dimensions of these derivatives differ little from those of the untreated cellulose. It is pointed out that this fact is a necessary condition for assuming a topo-chemical reaction. Cellulose fibres obtained by the denitration of a cellulose nitrate and from the hydrolysis of a cellulose acetate, both of them being prepared from an untreated cellulose, give the diagram of the latter. On the other hand, cellulose regenerated from esters prepared from a mercerised cotton gives the diagram of cellulose hydrate. The dimensions of the crystallites of nitrated and acetylated hemp cellulose are given, the esterification being carried out under conditions in which the fibrous structure is maintained. Particular emphasis is placed on the fact that the size of particles in colloidal solutions of cellulose nitrate as determined by the diffusion method corresponds exactly to the dimension of crystallites computed from the X-ray diagram. The size of particles of cellulose of various origin and pre-treatment is given. —B.C.I.R.A.

Cellulose: Effect of Heat. J. W. Bain and G. F. Kay. *Chem. Abs.*, 1925, **19**, 893 (from *Trans. Roy. Soc. Canada*, 1924, **18**, 269-272).

Cellulose was heated at temperatures between 190° and 250° and then extracted with water. The extract gave an osazone after separating resinous impurities, which, after washing with cold absolute alcohol, melted at 202-203°. After such extraction the cellulose could be again reheated and fresh extract obtained. The extract reduced Fehling solution. Cellulose heated with water under pressure gave an extract which evaporated to a sirupy consistency. It reduced strongly but no osazone could be obtained. —B.C.I.R.A.

Mercerised Cellulose: X-ray Structure. J. R. Katz. *Z. Elektrochem.*, 1926, **32**, 125-128.

In a further investigation into the existence of an "alkali-cellulose compound" an X-ray examination was made of the swelling of cellulose in aqueous-alcoholic sodium hydroxide solution (instead of aqueous alkali alone), it being known that under these conditions the level portion of Vieweg's swelling curve disappears and there is complete proportionality between the amount of alkali taken up and the concentration of the solution. Swelling was performed with a 16% solution of caustic soda in 10% alcohol or a 16·5% solution in 35% alcohol and the product examined by means of X-ray after 20-24 hours. The typical spectrogram of cellulose swollen in caustic soda solution resulted, i.e., the original cellulose diagram disappeared completely and there remained only two sharp bands at the equator and approximately in the position of the new "mercerisation band." Further there appeared on the plate the amorphous ring of a diagram which apparently corresponds to the liquid between, and ultimately in the fibres. With more dilute caustic soda and longer time of swelling, the new and the old bands approach one another. Thus in swelling in aqueous alcoholic alkali solutions—even though the level portion of the Vieweg curve is lacking—the same Röntgen-spectrographic change occurs which occurs in aqueous solutions of approximately the same concentration (i.e., where the Vieweg curve changes direction) and which the author has assumed with tolerable certainty to represent the spectrogram of an "alkali-cellulose compound." Confirmation is afforded by the fact that if the fibres, after swelling in aqueous alcoholic solution, are washed with alcohol of the same concentration (not with water, but adding some glacial acetic acid in the second washing) until the soda is completely removed the cellulose after drying shows the typical diagram of a mercerised cellulose. Since these fibres have not been in contact with aqueous

soda solutions and yet show the typical mercerisation change, the author concludes that the "alkali-cellulose compound" is formed also on swelling cellulose in aqueous alcoholic solution. —B.C.I.R.A.

Viscose Solutions: Viscosity. R. Bernhardt. *Melliand's Textilber.*, 1926, **7**, 52-55 and 318-319.

Experiments on the effect of concentration, ageing, agitation, pre-heating, temperature, added salts and acids and hydrogen-ion concentration on the viscosity of viscose solutions are described and compared with the results of similar experiments on gelatin. The practical importance of some of the results is emphasised, for example, the effect on the viscosity of viscose solutions of a sodium chloride-hydrochloric acid precipitating bath as compared with sodium sulphate-sulphuric acid explains the unfavourable effect of a sodium chloride-hydrochloric acid precipitating bath in the manufacture of artificial silk. —B.C.I.R.A.

Artificial Silk: Swelling. W. Weltzien. *Melliand's Textilber.*, 1926, **7**, 338-343.

Some experiments on the swelling of artificial silk in water and in sodium hydroxide solutions of varying concentration are reported. Swelling in water is a reversible process. A remarkable parallel is found between the extension of artificial silk in air at loads slightly below the breaking load and the increase in length of the thread immersed in water. Swelling curves for a stretch-spun cuprammonium and a viscose silk in sodium hydroxide solutions show a maximum at about 10% concentration of alkali and it is suggested that this observation might form the basis of a method for differentiating artificial silks. Further information is obtained from a study of the changes in length of artificial silk threads in sodium hydroxide solutions. With increasing concentration of solution, viscose threads contracted until within the region of the swelling maximum when the length began to increase again. These changes are traced to the varying conditions of tension under which the threads were coagulated. Curves are reproduced for the cycle of processes involving swelling and de-swelling. Swelling in sodium hydroxide is an irreversible process but de-swelling is reversible. Only threads which have previously been treated with sodium hydroxide give values which are independent of "internal tension" and nitro, viscose, and cuprammonium stretch-spun silks of the same denier can be differentiated by the different concentrations of sodium hydroxide which produce the same change of length in the sodium hydroxide water de-swelling process. —B.C.I.R.A.

Artificial Silk Centrifugal Spinning Apparatus. R. Gey. *Melliand's Textilber.*, 1926, **7**, 334-338.

A general account of the advantages and development of the centrifugal apparatus, including 35 references to patents. —B.C.I.R.A.

Viscose Spinning Baths: Composition. —. Bayer. *Melliand's Textilber.*, 1926, **7**, 326-329

A critical review of the patent literature of the last ten years. —B.C.I.R.A.

Viscose Spinning Baths: Properties. E. Schülke. *Melliand's Textilber.*, 1926, **7**, 320-323.

Viscose spinning baths are classified according to their constituents and their properties are discussed. The patent literature contains so much overlapping material that a sharper differentiation between "new" and "analogous" processes is desirable. —B.C.I.R.A.

Artificial Silk Production in Germany. E. Opfermann. *Papier-Fabr.*, 1926, **24** (Verein Zellstoff-Ingenieure Section), 249-250.

The position in Germany of artificial silk and cellulose manufacture is discussed. It is urged that preference be not given to Scandinavian cellulose since, even if the German product is in any way inferior, the cellulose is always so treated by the artificial silk maker as to be suitable for his particular process. —B.C.I.R.A.

Wood Cellulose: Isolation. K. Berndt. *Papier-Fabr.*, 1926, **24** (Verein Zellstoff-Ingenieure Section), 233-238.

A review of the literature relating to the use of magnesium bisulphite solutions in the manufacture of sulphite cellulose pulp. —B.C.I.R.A.

Cellulose: Swelling of. R. O. Herzog. *Papier-Fabr.*, 1926, **24** (Verein Zellstoff Ingenieure Section), 226-227.

In a paper on the swelling of cellulose, the author discusses the question of where the conversion of the homo-polar radicle or molecule lattice into the hetero-polar ion lattice takes place. He discusses the unions between cellulose and electrolytes which swell in aqueous solutions and divides them into two groups, of which the first (unions with alkali hydroxides, &c., with Schweitzer's reagent and nitric acid) swell in dilute electrolyte solutions, and those in which unions occur between "fusions" (salts in their water of crystallisation) and cellulose. The swelling processes which belong to the first group obey

Fajan's rule for the solution of ions in concentrated solutions, but in the second group deviations from the rule occur. The action of the swelling agent on the crystal aggregate from volume increase to sol formation, is discussed. Apart from chemical combination, water, on account of its dipolarity, is attracted partly by the ions which lie bound on the surface of the lattice and partly by the free-moving ions which surround themselves by a water sheath. A theory is advanced for the mercerisation contraction which gives good agreement between the calculation and the measurement of the tension which maintains the equilibrium of the fibre contraction. At the basis of this theory is the assumption that the oblong crystallites, lying with their long axes in the fibre axes, are softened and tend to assume the spherical form. Since they are likewise surrounded by the liquid imbedding substances, forces appear in the surface. If a further tension be applied an equilibrium is established between this latter, the surface forces and the pressure in the interior of the crystallites transformed into droplets. Following on this the relationships are shown as they exist in a membrane built up of crystalline structural elements imbedded in a ground substance. The effect of swelling on the elastic properties (tearing strength and plastic extension) is explained. In conclusion it is shown that the change of state which the cellulose undergoes is to be attributed not to crystallisation processes (recrystallisation) but to coagulation (as in drying cellulose, and ripening viscose) or peptisation. The discussion mainly turned on the question of the existence in the fibre of a cement or ground substance. —B.C.I.R.A.

Sulphate Cellulose: Alkali Absorption. C. Kullgren. *Papier-Fabr.*, 1926, 24 (Verein Zellstoff Ingenieure Section), 153-155, 186-189, and 206-208.

In a study of alkali absorption by sulphate cellulose from black liquors the author first determined by a titration method the amount of alkali absorbed by sulphate cellulose from pure sodium hydroxide solutions under different conditions of temperature and concentration. A preliminary experiment showed that the absorption end point is reached fairly rapidly whether the solution is shaken or not. At 180° the sulphate cellulose absorbed 2·6% of its weight of NaOH from a solution containing 3·5 g. NaOH per 100 cc. Increasing temperatures up to 50° lowered the amount of absorption; at 75° there is degradation of the cellulose. Absorption is considerably greater with increasing concentration of the alkali solution. Curves are given showing the relation between absorption and concentration for Kraft cellulose and bleaching cellulose and the results compared with those obtained for cotton. Absorption is reversible. The absorption of caustic soda in presence of sodium carbonate and sodium chloride was determined by an electrical conductivity method; the presence of chloride increased absorption. The results of applying the conductivity method to determine alkali absorption by sulphate cellulose from black liquors are described and show that absorption is considerably higher from black liquor than from pure caustic soda solutions. —B.C.I.R.A.

Artificial Silk: Properties. O. Both. *Leipzig. Monats. Text.-Ind.*, 1926, 41, 40-41, 78-81.

A general article on artificial silk, touching on its process of manufacture, its physical properties, its price and production relative to natural silk and its poor dyeing character. Points to be considered in successful twisting and weaving of the thread are discussed. —B.C.I.R.A.

Alkali Cellulose Sulphiding Drum. Hansen. *Kunstseide*, 1926, 8, 116-117.

The drum is provided with several series of unevenly spaced knife blades. The blades are carried in frames which are rotatably fixed to the walls of the drum so that they can be swung out of the drum to allow for proper cleaning. The arrangement reduces the formation of lumps and the amount of incompletely sulphided alkali cellulose. —B.C.I.R.A.

Viscose: Ripening. J. D'Ans and A. Jäger. *Kunstseide*, 1926, 8, 17-19, 43-46, 57-59, 82-84, 110-111.

The most important methods available for following the ripening of viscose solutions are as follows—(1) "Ammonium chloride ripeness," that is, the amount of ammonium chloride required, under given conditions, to coagulate the viscose solution; this amount decreases with increasing age of the viscose solution. (2) Determination of the time required for auto-coagulation. (3) Change of viscosity. (4) Jentgen's method in which the sulphur compounds are titrated by iodine. (5) Leuchs' method in which carbon disulphide and hydrogen sulphide are estimated. Details are given of Jentgen's method which the authors have used. Experiments on a large number of viscose solutions show that the decrease in the number of xanthate groups is regular and that the rate of separation of xanthate groups increases with increasing temperature. There is a clear relationship between the number of xanthate groups and the properties of a viscose solution. Ammonium chloride ripeness depends on the degree of degradation of the cellulose, the number of xanthate groups still retained, the quantity of electrolytes contained in the solution, the free sodium hydroxide content of the solution and the temperature. The sodium hydroxide content is particularly important, a high content increasing the stability of the

solution to ammonium chloride; the method of making the determination also affects the results. The time required for auto-coagulation decreases with increasing temperature. Ammonium chloride ripeness decreases very rapidly in the first few days after preparation of the solution, then more slowly, whilst the time required for auto-coagulation is represented by a straight line and comparison of the two methods, even in the region just prior to auto-coagulation shows that ammonium chloride ripeness is not a sharp indication of the occurrence of auto-coagulation. Viscosity determinations in an ordinary flow viscosimeter with solutions diluted to three times their volume, and in the Kochius instrument show that for technical purposes the results agree, but they do not agree if the sodium hydroxide content of the viscose solution is essentially higher or lower than that of commercial solutions. The sodium hydroxide content of the solution has a very considerable effect on the results of viscosity and ammonium chloride ripeness determinations and must be taken into account when these methods are used to study the state of a viscose solution. The effect of excessive mercerisation in the preparation of the soda-cellulose and of different percentages of carbon disulphide in the preparation of the xanthate on the viscosity and ripeness of viscose solutions is shown in tables and curves. The stability of viscose solutions towards auto-coagulation increases with increasing xanthogenation, but degree of xanthogenation has a less effect than the sodium hydroxide content; it has, however, a greater effect on ammonium chloride ripeness than has alkali content. The effect on ripening of the addition of electrolytes—sodium sulphate, carbonate and sulphite—and also gelatin, tannic acid, glycerol, dextrose, cane sugar, gallic acid, and resorcinol has been studied. The three sodium salts shorten the time of coagulation, the sulphite having the least effect. The ammonium chloride ripeness is little influenced by the sulphate and carbonate, but indicates retarded ripening in the presence of the sulphite. The behaviour of viscose solutions in the presence of sodium sulphite is thought to be of technical importance and an explanation is suggested. Experiments with a wide variety of other added substances, particularly metallic salts, have led to no definite results. In experiments in which sodium carbonate was added to viscose solutions, crystals were formed which were identified as the double salt, potassium sodium carbonate. The crystals are found under works conditions when sodium carbonate has been introduced into the viscose solutions either by the cellulose, sodium hydroxide or water used and the concentration of sodium hydroxide is sufficient to allow the formation of the double salt. —B.C.I.R.A.

Patents

Artificial Silk Spinning Machine: Driving Mechanism. O. Kohorn & Co. and A. Lehner, Chemnitz, Germany. E.P. 250,198.

The arrangement of the gears for driving the various elements in machines for spinning artificial silk, claimed in Specification 241,190, is modified in order to simplify the gearing and to reduce the space required. The main shaft is connected by a change wheel or by change gearing operated by a handle with the geared lower cone shafts from which the pump shafts are driven by horizontally arranged gearings which include change gearings operated by a handle or a change wheel, and the traverse mechanism is driven by vertically arranged gearing. Both horizontal and vertical gearing are enclosed in casings which serve as oil baths. The cone belt-shifting and tensioning lever is interlocked with the clutch levers of the top cones so as to prevent the row of operative bobbins being stopped when the corresponding cone belt is tensioned.

—B.C.I.R.A.

Artificial Silk Spinning Jets. W. Schulz, Lichterfelde, Berlin. E.P.250,202.

The projecting tubular members constituting the spinning jets of a nozzle for spinning artificial silk, &c., are of conical internal section tapering towards the outlet, and their outlet edges are brought to a knife edge. By this construction, filament formation takes place more smoothly and the jets cannot become obstructed by solution congealing at the outlet. It is preferred to increase the size of the outlet orifice to 1·5 mm. or more; this is particularly desirable when for winding-up of the threads a high reeling speed is employed.

—B.C.I.R.A.

Viscose Silk: Preparation. P. Moro, Marseilles, France. E.P.250,219.

The proportion of carbon disulphide and of caustic alkali is decreased, and the time of manufacture reduced, by employing for the preparation of viscose a solution of sulphur in carbon disulphide, applied to the alkali-cellulose either in the liquid state or as vapour, or in the condition of fog. Thus, the alkali-cellulose pressed to 225-250 parts for every 100 parts of cellulose, is treated at 30-40° C. with 15-25 parts of a solution of sulphur in carbon disulphide; after 12-24 hours the product is dissolved in water or dilute caustic soda solution, and the solution after standing for 24-36 hours at 25-30° C. and subsequent filtration and separation of air, is suitable for spinning. Alternatively, alkali-cellulose may be spread on sieves in towers through which the vapour of carbon disulphide laden with sulphur is drawn from a tank by means of a pump, residual vapours being collected in a condenser, or the

solution of sulphur in carbon disulphide may be atomised and drawn through the towers in a similar manner, but the towers should be heated to 40-45° C.; the pump serves finally to eliminate the excess of carbon disulphide from the mass.

—B.C.I.R.A.

Alkali Cellulose: Ripening. Soie de Châtillon Soc. Anon., Milan, Italy. E.P.250,617.

The ripening of alkali cellulose is retarded or arrested by conducting the operation either in the presence of inert gases or in an atmosphere free from oxygen, or in a vacuum. Alternatively, the ripening may be accelerated by the employment of an atmosphere of oxygen or one which is rich in this gas. —B.C.I.R.A.

Artificial Silk Threads: Spinning. L. A. Levy, Cricklewood, London. E.P. 250,683.

In the spinning of artificial filament threads from cellulose acetate and equivalent materials, the filaments suitably gathered to form a thread, are wound up on a ring-spinning frame. The filaments may be squirted through nozzles of the construction described in Specification 213,138, and they may be deprived of their solvent by the method described in Specification 168,986, final traces of solvent being removed by passage round a heated drum as described in Specification 219,106; or a setting bath may be used for coagulating the filaments. —B.C.I.R.A.

Cellulose Ester Solvents and Glycol Ether-esters: Application and Manufacture. I. G. Farbenindustrie A.-G., Frankfort-on-Main, Germany. E.P.251,303.

Solutions of organic substances such as cellulose derivatives, resins, waxes, siccatives, dyestuffs, fats, oils, soaps, &c., are formed with the aid of mono-aryl ethers of glycols or the esters of organic acids (including carbonic acid) with mono-alkyl or aryl ethers of ethylene glycol or its homologues. The glycol derivatives may be employed alone, with other solvents or with plasticisers. The esters of glycol mono-alkyl ethers are especially suitable for making cellulose lacquers, plastics, and films. The esters boiling below 200° C. are best used as solvents whilst those boiling above 200° C. and the aryl ethers and their esters are mostly used as plasticisers. Thus, the formates, acetates, and propionates of methyl, ethyl, propyl, or isopropyl ethers of ethylene or propylene glycol are employed as solvents, whilst the esters of aromatic mono- or poly-carboxylic or sulphonic acids or of aliphatic poly- or hydroxy carboxylic or sulphonic acids with alkyl ethers of ethylene or butylene glycol or glycerol are used as plasticisers. Some examples are given of the solution of pyroxylin, cellulose acetate, a cellulose ether, and caoutchouc. —B.C.I.R.A.

Artificial Silk Spinning Apparatus. British Celanese, Ltd., London, E. Kinsella, and H. E. B. Young, Spondon, Derby. E.P.251,319.

In cop spinning apparatus for artificial silk the slow building-feed mechanism, whether actuating the cop spindles or the cops, is arranged so that the building-feed can be stopped in respect of any one, or alternatively any pair of cops or pirns without stopping the winding motion.

—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Production of Artificial Fibres—
250,580. E. H. J. Rebsomen. Gear pump for viscose distribution.

Production of Vegetable Fibres—
251,360. R. Boby Ltd., and others. Flax-pulling machine.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Raw Cotton: Oiling. *Amer. Dyestuffs Rep.*, 1926, **15**, 162-165.

A report of a discussion relating to the advantages and disadvantages of oiling cotton before dyeing. Some speakers felt that with proper humidification oiling is not necessary. The suggestion was also made that by storing seed cotton for a period before ginning the hairs would absorb oil from the seed and be improved thereby. —B.C.I.R.A.

Flax Retting; Preliminary Studies in. A. G. Lochhead. *Bot. Abs.*, 1926, **15**, 356 (*Canada Dept. Agric. Exp. Farms, Rept. Dominion Agric. Bact.*, 1924, **17-18**, 1925).

Preliminary studies were made on the effect of temperature on the retting process, both as regards time to complete the ret and the strength and spinning values of the resultant fibre. Tests were also carried out on the "Kayser Process."

—L.I.R.A.

Buckley Beater: Application. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **90**, 528-529.

It is believed to be an advantage to use a Buckley type of beater in the breaker pickers. More motes and less good fibre are obtained in the waste and the Buckley beater is said to injure the breaking strength of the cotton less than the blade beater.

—B.C.I.R.A.

Finisher Lap: Effect of Variation in Weight. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **90**, 529.

In a discussion on the difference in the variation of the finished roving when allowing 2 lb. variation in the weight of the finisher lap instead of the customary 1 lb., it is stated that in tests in which some laps were held to a standard variation whilst others were allowed to run wild, and the finished drawing was weighed, there was no difference in the evenness of the yarn from the two sets of laps.
—B.C.I.R.A.

Drawing. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **90**, 529-531.

The value of one as compared with two processes of drawing is discussed but no general conclusion is reached.
—B.C.I.R.A.

Roving Waste: Treatment. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **90**, 531.

It is given as the concensus of opinion that white waste from the drawing frames and slubbers should be returned to the regular run of stock, treated as lightly as possible and not reworked at all.
—B.C.I.R.A.

Fly Frame Drafts. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **90**, 531.

A short discussion of speed frame drafts and the distribution of draft over the various drawing processes. —B.C.I.R.A.

Raw Cotton: Opening. "M.C." *Cotton* (U.S.), 1926, **90**, 551-556.

It is pointed out that on account of economic conditions the manufacture of fine yarns and fabrics is gradually moving southwards in the U.S.A., and in this connection the opening and picking of long staple cotton is discussed, since the process requires more care than the opening of short cotton. In particular, conditioning ("ageing") the broken bale before scutching is urged. —B.C.I.R.A.

Combing Machine Feed Roller Gauge. *Cotton* (U.S.), 1926, **90**, 559.

The gauge, which was designed for use with Platt's Heilman comber, is made from sheet brass or iron and carries a plumb line and bob and a numbered scale. By placing it in a certain position on the feed rollers the top roller can be set perfectly parallel with the bottom roller.
—B.C.I.R.A.

Artificial Silk: Oiling. E. R. Woodward. *Text. World*, 1926, **69**, 1827-1829.

A general article dealing with the types of oil used and the methods of application.
—B.C.I.R.A.

"Whitin" Two-beater Breaker Lapper. Whitin Machine Works. *Text. World*, 1926, **69**, 2349.

The machine consists of a large capacity reserve box hopper feeder, a 41 inch upstroke Buckley beater with an evener motion, and an 18 inch three-bladed beater section. The makers claim that a lap sufficiently even to obviate the use of an intermediate picker is obtained, that the reserve box causes the cotton to be distributed evenly over the whole width of the machine and that the improved hopper feeder and upstroke Buckley beater produce cleaner and more lustrous laps than those processed by a breaker and an intermediate picker. —B.C.I.R.A.

Carding and Drawing. *Text. World*, 1926, **69**, 2695, &c.

A plea is made for freer and more general discussion at the meetings of the National Association of Cotton Manufacturers (U.S.A.) and is accompanied by a reproduction of a typical discussion as reported in the Transactions of the Association for 1874. At this meeting a paper was read on the effect of carding on the individual cotton hair, as revealed by the microscope, and interesting opinions were expressed as to damage done between carding and the first roving and to damage by rubbing in the card. —B.C.I.R.A.

Gégauff Continuous Card-stripping Beaters. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 81-82.

A device for rendering ordinary card-stripping unnecessary comprises a double beater carrying combs and placed above the taker-in and below the flats. The function of the comb is to lift the cotton hairs on to the surface of the small doffer combs, at the same time subjecting them to a certain amount of combing, whereby short hairs and mechanical impurities are removed. The cotton, which then lies open in the cylinder clothing, can be more efficiently combed by the flats and the flats do not need stripping. —B.C.I.R.A.

Cotton Seed Delinting Machine. J. G. Brown and F. Gibson. *Rev. App. Mycol.*, 1926, **5**, 92 (from *Arizona Agric. Expt. Sta. Bull.*, 1925, No. 105, 381-391).

The authors describe in detail the construction of a simple and relatively inexpensive machine for the bulk treatment of cotton seed with sulphuric acid for the purpose of delinting, stimulating germination and destroying seed-borne parasites. The type described is capable of dealing with 50 galls. of seed every 3 to 15 minutes, according to variety and the grade of the acid. It costs about 400 dollars to construct, and allowing for cost of the acid, labour, and depreciation, the cost per acre is about 18-20 cents. —B.C.I.R.A.

Artificial Silk: Winding. W. Binder. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 44-45.

The article deals with the appearance in artificial silk of irregularities in lustre, which give rise later to irregular dyeing effects, &c., and which are caused by a stretching of the filament in the winding process. Notes are given on the correct way of handling artificial silk in winding and on certain winding devices designed by the Schweiter A.-G. —B.C.I.R.A.

Opening Machinery. P. Wisian. *Melliand's Textilber.*, 1926, **7**, 427-428.

A series of cotton opening and preparing machines built by Krupp's is briefly described. —B.C.I.R.A.

Condenser Card Lap-divider Bands and Rubbing Leathers: Control. L. Baumann. *Melliand's Textilber.*, 1926, **7**, 409-411.

Practical directions are given for the treatment of web-divider bands and rubbing leathers before and during use. —B.C.I.R.A.

Artificial Silk Winding Machine. A. Keuter. *Melliand's Textilber.*, 1926, **7**, 357.

The importance of careful handling, chiefly in the prevention of knots and stretching, is emphasised and attention is drawn to the "Perfect" swift and spindleless winding machine constructed by the Brügger Co. who guarantee that artificial silk wound on this machine is knotless and unstretched. The machine can be run at any speed between 60 and 240 metres per minute. —B.C.I.R.A.

Artificial Silk Reeling Machine. E. Ullrich. *Melliand's Textilber.*, 1926, **7**, 343-344.

The effect of variable tension in reeling artificial silk and its appearance in the woven fabric as shiny places is discussed. Attention is drawn to a reeling machine constructed by Zangs of Crefeld. —B.C.I.R.A.

(B)—Spinning and Doubling

Le Blan-Roth High Draft System; and a Four-roller High Draft System. Saco-Lowell Shops. *Text. World*, 1926, **69**, 63.

The Le Blan-Roth system has a bottom endless leather apron which passes round the back bottom roller and over a steel plate or bar which takes the place of the bottom middle roller. The bottom back roller is diamond knurled to give motion to the apron. The middle top roller, which rests on the apron, is of small diameter and fluted. In the four-roller system the rollers are similar to those used in the original three-roller system, with an additional pair of small diameter between the front and middle rollers. —B.C.I.R.A.

Woollen Roller Cloth: Application. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **90**, 533.

An all-wool cloth is recommended for covering roving and spinning frame rollers. The number of rollers used is reduced and the work runs better. —B.C.I.R.A.

Cork Covered Rollers: Application. Textile Operating Executives of Georgia. *Cotton* (U.S)., 1926, **90**, 533.

The rollers are much more durable than leather covered rollers. Discussing the subject, one speaker maintains that the breaking strength of the yarn is slightly higher with leather covered rollers, but a second speaker maintains that there is no difference. —B.C.I.R.A.

Spinning Frame Roller Stand: Angle of Inclination. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **30**, 534.

The elevation of the angle of spinning frame rollers from 25 to 35° is recommended. The change brings the front roller nearer to the guide wire, thus reducing the amount of yarn between the roller and the traveller, and the yarn is relieved to a considerable extent from the drag on the bottom front roller, since it passes in a straighter line between the back roller and the guide wire. —B.C.I.R.A.

Casablancas High Draft System. C. R. Harris and R. W. Philip. *Cotton* (U.S.), 1926, **90**, 521-524.

Certain American mills are installing the Casablancas system, an account of which is given. Comparative tests (N.B.—Only eight on each yarn) showed the Casablancas spun yarn to have less than one-half the variation found in the yarn produced on the regular system. —B.C.I.R.A.

Electric Spinning Frame Driving Gear. R. Fischer. *Leipzig. Monats. Text.-Ind.*, 1925, **40**, 332-333, 379-381.

The article describes improved methods of individual electric drive for spinning and doubling machines designed by the Zimmermann Werke A.-G. The types illustrated include—(1) A multiple pulley belt drive for spindles, allowing of running at four different speeds, (2) a cross rope drive for a worsted ring doubling machine, (3) a drive from a single motor to turn spindles at variable speeds, the two sides of the machine being independent. —B.C.I.R.A.

Four-roller High Draft Mechanism. E. Toenniessen. *Leipzig. Monats. Text.-Ind.*, 1925, **40**, 328-331.

In the first three-roller high draft system constructed by the author the distance between the middle and back rollers was 45 mm. Observation during drawing showed that drafting was taking place not

only between the front rollers and the drafting rollers but immediately behind the drafting rollers and decreasing gradually to the nip of the back rollers. To eliminate this arbitrary draft a further pair of rollers was introduced as closely as possible behind the drawing rollers, the top roller being weighted by special means, comprising a saddle combined with the saddle which weights the front top roller. The advantages of this system are indicated and yarn spun on it is said to be less hairy than a normally spun yarn. The Johannsen fluted roller may be advantageously incorporated in the four-roller mechanism. A five-roller system is also illustrated in which a second pair of drawing rollers is placed behind the saddle-weighted rollers, so that there are two drawing systems one behind the other. Experiments show, however, that equally good results are obtained with the four-roller system. In the four-roller system the plane of the drawing field is broken so that the nip of the drawing rollers is 1-1·5 mm. above the nip of the front rollers. —B.C.I.R.A.

Weight Control in Worsted Spinning. K. Trommer. *Leipzig. Monats. Text.-Ind.*, 1925, **40**, 288.

Differences in the weight of worsted bobbins are mostly caused by the fact that the bobbins are left all night before they are weighed and on account of this water added for purposes of oiling has partly evaporated. To minimise this difficulty it is advisable to determine the weight of the fibres before oiling. For low counts it is sufficient to weigh once. As the weight of the bobbin easily changes during the preparation, it is necessary to take several weights for the high counts. To eliminate the influence of the different humidities a conditioning apparatus should always be used for these weights. —B.R.A.W. & W.I.

Hartmann Copping Rail. F. Engelmann and A. Baumann. *Leipzig, Monats. Text.-Ind.*, 1925, **40**, 244-246.

The simplified copping rail with two instead of three copping plates designed for the Hartmann mule is described in detail. It may be used for forming warp and weft cops. —B.C.I.R.A.

"Perfect" Ring Frame. O. Johannsen. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 126-129.

A new design of spindle embodied in the "Perfect" ring spinning frame is described in detail. The spindle is operated by a worm wheel drive. The makers are the Perfect Spindle A.-G., Windisch, Kt. Aaargau, Switzerland. —B.C.I.R.A.

Fluted Roller High Draft Systems: Advantages. E. Toenniessen. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 93-95.

The author controverts Lehmann's views on the advantages of fluted over smooth rollers in high draft systems and gives a number of results which he has obtained by employing both smooth and fluted rolls in the Jannink and in his own four-cylinder systems. The results are in favour of smooth rollers. —B.C.I.R.A.

(C)—Subsequent Processes

Houghton Self-regulating Tension Device. Houghton Mfg. Co. *Text. World*, 1926, **69**, 1275.

A device is described which operates by balancing the minimum yarn strain against the desired tension. In this way the yarn itself is compelled to change its tension to offset the variations in yarn strain during spooling and winding. The yarn bearings consist of two series of intermeshing porcelain rollers, 2 in. long, one set pivotally mounted. These rollers are fastened to a sliding frame that is moved across the yarn path while the yarn is running. This movement is sufficient to provide new yarn bearings, thereby utilising the length of the rolls. The latter have an individual adjustment. By turning them one-quarter round and again using the slide adjustment along their length a yarn-bearing surface equal to 20 new tensions is provided without expense of new parts. —B.C.I.R.A.

Linen Yarns: Effect of Sodium Sulphide. P. P. Victoroff. *Melliand's Textilber.*, 1926, **7**, 61-63, 444-445.

Comparative experiments on the effect of sodium sulphide and sodium hydroxide solutions in the boiling out of linen yarns show that for solutions of equivalent sodium hydroxide content (produced in the sodium sulphide solution by hydrolysis), the sodium sulphide solution has the greater purifying effect. If the solutions are prepared to contain the same percentages of sodium hydroxide and sodium sulphide calculated on the weight of the yarn, in which case the sodium hydroxide content of the hydroxide solution is four times that of sodium sulphide solution, the sodium hydroxide has a greater effect in the removal of the pectins and other incrusting substances. The fibre is improved by treatment with sodium sulphide solutions more than by sodium hydroxide. By prolonged application and at high concentrations, sodium hydroxide solutions have a definite detrimental effect on the fibre, causing partial solution of the cellulose. The lustre, softness, and white of the yarns treated with the sulphide solution are in no respect inferior to these properties in the yarns treated with sodium hydroxide. —B.C.I.R.A.

(D)—Yarns and Cords

Rope: Imperfect Flexibility. G. Bisconcini. *Physikal. Ber.*, 1925, **6**, 889 (from *Lincei Rend.*, 1925 (6), **1**, 15-21).

If a weight is raised by means of a flexible inextensible thread passed over a solid

roller the two parts of the thread which do not lie on the roller have the direction of tangents to the roller circumference placed at the ends of the horizontal diameter. If the thread is replaced by a rope, the rope begins to cling to the roller at a higher point, and so the free upward moving section is at a distance from V (a vertical through the middle of the roller) which is slightly greater than r (the radius of the cylinder). Conversely, the downward moving free section of the rope leaves the cylinder at a point such that the distance between the rope and V is less than r. The author shows that this phenomenon may be presented analytically by assuming the existence of appropriate internal forces which act in the rope in the position in which a curvature variation (between the curvature limits o and $1/r$) occurs.
—B.C.I.R.A.

PATENTS

Grid for Scutchers and Cards. Société Laroche & Fils. F.P.594,192.
The grid is formed by a steel plate holed with many slits which are beaten out so that each side of slit forms a boss inside the grid and a hole outside. These slits are perpendicular to the direction of rotation of the cylinders. —Bur. Text.

Thread Clearer. Société E. and L. Constant. F.P.595,251.
This system comprises a series of thread clearers formed with a fixed and an adjustable steel plate. The regulation of all adjustable steel plates is obtained at the same time by a single driving rod upon which they are fixed. The displacing of this rod is made by a screw. —Bur. Text.

High Speed Spinning Bobbins. Industrie A.-G. Allegro, Lucerne, Switzerland. E.P.250,137.
Spools for high speed spinning comprise a drawn metal tube which may be of aluminium, having lugs by which the end flanges and a drawn metal driving sleeve are rigidly secured. The flanges may consist of an artificial mass, of wood or of metal. The driving sleeve may be omitted and a central guiding tube may be provided. The metal tube may be perforated to facilitate moistening of the yarn.
—B.C.I.R.A.

Spinning Machine Flyer. J. F. Houghton, Heaton Norris, near Stockport. E.P. 250,300.
In a flyer for spinning or like machines, the yarn passes through an inclined hole into a diametral hole and twists about a point, on or approximately on the axis of the flyer. The inclined hole may be of inverted frustro-conical shape with the lower edge approximately on the flyer axis, or a large cylindrical hole containing a shoulder extending to the flyer axis. Peripheral threading apparatus may be provided.
—B.C.I.R.A.

Bobbin Shaft Driving Mechanism. J. Hetherington & Sons, Ltd., Ancoats, Manchester, and L. Helmsley, Heaton Chapel, near Stockport. E.P.250,434.
In slubbing, intermediate and roving frames of the kind in which the bobbin shafts are driven by an endless chain, belt, or the like kept uniformly taut by means of a rotary tension member which rises and falls about a pivotal centre, the chain is passed around an idler eccentrically mounted on a wheel or drum, so that when the bobbin rail rises, the idler is lifted and rotates the wheel, which is rotated in the reverse direction by a weight when the bobbin rail falls. —B.C.I.R.A.

Yarn Gassing Machine. A. Mettler, Reichenburg, Switzerland. E.P.250,569.
Apparatus for singeing threads comprises an outer tube within which is fitted a tubular member cut away to form a chamber and provided with diametrically opposed slots. Packing material is fitted in grooves. The tube and member are longitudinally slotted to allow the introduction of the thread. Gas is supplied to the chamber by a pipe and burns at the slots. The tubular member is coned out at its ends to facilitate the escape of combustion residues. The walls being thin will glow and increase the singeing action. An additional metal tube slotted to register with the slots of the first tube may be inserted therein and turned to adjust the slots. —B.C.I.R.A.

Yarn Gassing Burner. E. Turner & Co., Manchester. E.P.250,704.
In the singeing of yarns, tapes, and the like, each burner is formed streamline-wise in cross section with upstanding ridges slotted or drilled in the manner shown. The spaces or channels between the ridges constitute air passages producing oxidising flames. Air may be projected into the channels by separate jets and the air pipe therefor may be external or it may be integral with the burner pipe.
—B.C.I.R.A.

Roller Drawing Heads. G. Fraser, N. Fraser, and J. Fraser, Arbroath, Forfarshire. E.P.250;772.
In spinning and twisting machines the back or pressing roller is relieved from the action of the weight lever when it is desired to remove it for repair or replacement by means of a pivoted latch, which is normally sustained by a spring buffer device, but, when the lever is manually operated to relieve the pressure and the buffer device swings about its pivot, falls and engages a spur on the lever and holds it in its retracted position The latch may be pivoted on the lever and adapted to engage a part fixed to or integral with the bracket that carries the lever. A snug is provided to limit the movement of the lever if it is accidentally released when not under control. —B.C.I.R.A.

Winding Machine Creel Bobbin Rocking Motion. Harling & Todd, Ltd., and J. T. Booth, Burnley. E.P.250,773.

The supply or creel bobbins in winding machines are supported so that they may have a circular rocking motion as the yarn is drawn off endwise. For modern ring bobbins a holder is freely supported between a flange and a retaining washer on a central support secured in a hardwood footstep. For the old type of ring bobbin or for holders for paper tubes the support is provided with a rounded top. —B.C.I.R.A.

Comber Upper Nipper Waste Clearer. J. W. Nasmith, Heaton Mersey, Manchester. E.P.250,821.

In an arrangement in which the accumulation of waste, &c., in the top comb is prevented by means comprising a member in operative connection with the upper nipper jaw and moving with the nipper jaw down the teeth of the comb as the nipper closes, the blade is adjustable to remain close to the comb, when the distance between the comb and the nipper is adjusted. The moving member is carried by an arm pivoted to the nipper arm. It may be carried in a slide on the top-comb frame and may fall by its own weight, being raised by projections on the blade engaging over the top nipper jaw. —B.C.I.R.A.

Spinning Machine Moistening Device. I. Linon and J. Dethier, Ensival, Belgium. E.P.250,915.

In a pneumatic arrangement for preventing doubles in mules or continuous spinning frames, one or two independent devices for producing humid air are mounted on each machine of the installation. A fan driven by a motor controlled by a rheostat delivers air to a pipe running along the roller head of the mule. The air is humidified by a spray at the inlet to the fan. The air travels in a more or less closed circuit. An air pump may be substituted for the fan. —B.C.I.R.A.

Spinning Spindle Driving Mechanism. J. C. Leslie and D. Keay & Leslie, Ltd., Dundee. E.P.251,028.

The spindles of a spinning machine are driven from a tin roller the bottom of which is level with the driven warves of the spindles, the horizontal parts of the belts being arranged to be loose and to be tensioned by vertical jockey pulleys carried on bell-crank levers retracted by weights attached to the levers by threads. In the form shown, the ends of the bell-crank lever are pressed back by rods secured to weighted levers. The weighted end of each lever can be pressed by the operator's knee so as to bring it into contact with the spindle warve to stop the spindle, the movement of the lever simultaneously bringing the jockey pulley off the belt so as to slacken it. —B.C.I.R.A.

Spinning Frame Doffing Apparatus. R. B. Buchanan, Hamilton, Ont., Canada. E.P.251,156.

A casing moved along the frame and retained in front of a series of spindles, carries mechanism operated by a handwheel so as to cause arms which carry chucks to remove the full bobbins and deposit them in a hopper and to withdraw empty bobbins from hoppers and place them on the spindles, the yarn being automatically removed to the rear of the spindles before the bobbins are doffed and afterwards severed. —B.C.I.R.A.

Winding Machine. A. Boesch, Geneva, Switzerland. E.P.251,288.

For descriptive matter see E.P.235,908 (this *Jl.*, 1925, **16**, A306). The claims of the present specification have particular reference to the construction and arrangement of the cams that operate the traverse mechanism. —B.C.I.R.A.

Sliver Guiding Device. E. Fievet, Lille, France. E.P.251,452.

Members for supporting, guiding, and carrying fibres during their treatment in preparing machines are provided with ribs, wings, or projections, arranged in the direction of displacement of the fibres. The fibres slide along the tops of the ribs, &c., and the impurities fall between them and are carried along in the grooves or evacuated through holes in the bases of the grooves. The ribs, &c., may be soldered or otherwise secured to the base and be either perpendicular or inclined to it. The guide plate, &c., may be made of aluminium and the ribs, &c., be cast in position. The guiding devices used in carding engines to transfer fibres which fall on them to the under-casing may be provided with sheet iron rings spaced apart by discs. —B.C.I.R.A.

Distinctively Marked Artificial Silk Threads: Preparation. Soc. pour la Fabrication de la Soie Rhodiaseta, Paris. E.P. 251,580.

The application of a fugitive and temporary colour to dry-spun threads of cellulose esters, ethers, &c., for the purpose of distinguishing threads of different nature is effected either upon the elementary filaments before union into threads or upon the moving threads before or during reeling. Organic or inorganic colours may be used, in solution, suspension, or emulsion, or as pastes, jellies, or solids, and may be applied by passing the threads over rollers, pads, or impregnated surfaces, by passage through baths, or by atomising, spraying, or rubbing. The operations may be performed within or without the spinning cells. Further differentiation may be obtained by colouring a given thread in portions only, or by applying different colours to

different portions of one thread, or by colouring only some of the elementary filaments, the others being left uncoloured or coloured differently. Some examples are given. —B.C.I.R.A.

Cotton Yarns: Wet Spinning. N. Alexeeff and G. Petroff, Moscow. E.P. 251,590.

In wet-spinning processes, the wetting is effected at the ordinary temperature by adding to the water salts of naphtha sulphonic acids, aromatic sulpho-fatty acids, sulphonated fats and analogous substances having a wetting action. The rove may be wetted in the spinning or beforehand on bobbins. Solutions of 0·05% concentration or more may be used. —B.C.I.R.A.

Yarn Winding Mechanism. Tubize Artificial Silk Co., of America, Philadelphia, U.S.A. E.P.251,603.

In bobbin winding mechanism, especially such mechanism used in combination with means for exuding filaments of artificial silk, the guides are operated by a rotary drum cam of variable throw, which is moved longitudinally so as to impart a progressively shorter traverse. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Preparatory Processes—

250,031. E. Hopwood. Combs: rotary clearing brush.

250,710. J. Crossley & Sons, Ltd., and others. Screw gill box: brush clearer.

251,576. J. Crossley & Sons, Ltd., and others. Screw gill box: cleaning brush mounting.

Spinning—

250,456. E. Hartley. Spinning frame: Drawing roller supports.

251,123. J. Dugdale. Spinning frame: roller covering attachment.

251,537. W. Prince-Smith and D. Waterhouse. Spinning frame: doffing arrangement.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Weighting of Silk. F. H. Untiedt. *Text. Col.*, 1926, **48**, 387-390.

Abstracts are given of about 35 processes for weighting silk and protected by English, German, and French patents. —A.J.H.

Jacquard Cards: Cording. *Leipzig Monats. Text.-Ind.*, 1926, **41**, 82-85.

Four methods of Jacquard cording known as the English or open harness, the Chemnitz, the Elberfeld, and the Crefeld methods are described and compared. In the open harness and Chemnitz methods the tie-up is from the back left forwards, in the Elberfeld method the tie-up is from the left forwards to the back and in the Crefeld from the right forward to the back. In cutting the pattern cards the cutter must bear in mind that there are four possible starting points for the pattern and attention must also be paid to whether the fabric is to be woven with the right or the wrong side upwards in the loom. The right tie-up out of the four possible ones for producing a given pattern is illustrated for each of the four cording methods. —B.C.I.R.A.

Jacquard Card Reading-in Machine. M. Walther. *Melliand's Textilber.*, 1926, **7**, 222-223.

An automatic reading-in machine which considerably simplified the preparation of jacquard cards is described. —B.C.I.R.A.

(B)—Sizing

"Biolase" and Starch Constitution. H. Pringsheim and E. Schapiro. *Ber.*, 1926, **59**, 996-1000.

A new starch degradation by the ferment "Biolase" (Kalle) is described. The enzyme is stable towards heat and can split starch at high temperatures without the formation of perceptible quantities of reducing sugars. It is stable towards OH′ ions and is active over a pH range of 5·4-7·0. In alkaline medium the optimum pH is 7·6. While incapable of reducing maltose to glucose at a high temperature, the enzyme is able to produce glucose at lower temperatures (37°), and also a reducing sugar which is a trisaccharide. The trisaccharide was isolated by conducting the Biolase amylolysis at 70° and was found to have the formula $C_{18}H_{32}O_{16}$ and a constant rotation of 128-129°. These constants and the decomposition point of the osazone (120-122°) indicate that the trisaccharide is identical with the "β-Glucoside-maltose" of Ling and Nanji, which is also confirmed by the similar behaviour of the two sugars towards enzymes. The enzyme (emulsin-amylase) reactions lend support to the view that "Isomaltose" is no normal β-glucosidic disaccharide but is rather a stable γ-glucosidic complex from starch, and confirm the assumed identity of emulsin- and pancreas-amylases (α-amylases). —B.C.I.R.A.

Diastase: Saccharifying Test. V. Syniewski. *Bot. Zentr.*, 1925, **148**, 345 (from *Bull. intern. Acad. Polon. sc. et lettr. Cracovie, Cl. sc. math. et nat.*, Sér. B, 1924, 149-151).

By using Lintner starch in estimating saccharifying power an error arises due to the entire quantity of diastase present not

being used up. If the age of the starch solution is less than five hours the error is not appreciable but it is noticeable in older solutions. —B.C.I.R.A.

Adhesive Dextrin Paste: Preparation. H. Utaka. *Chem. Abs.*, 1925, **19**, 2278 (from *Rep. Osaka Ind. Research Lab., Japan*, 1925, **5**, 1-7).

Potato and tapioca starches were hydrolysed with various quantities of 0·5% nitric acid at different temperatures and for different lengths of time. The adhesive power was determined by Schopper's apparatus. The higher the temperature, the longer the heating and the greater the concentration of the acid, the more dextrin and reducing sugar are formed. The reaction is quicker with tapioca than with potato starch, but the latter gives a more adhesive paste. If the 50% paste is used directly, the adhesive power increases with the dextrin content up to 75-85% then decreases. If 50% paste is dried first, remoistened with water and then used, its adhesive power increases with increasing dextrin content; even the paste containing 90% dextrin shows no increase. The presence of a more difficultly soluble dextrin in the paste is responsible for this discrepancy. —B.C.I.R.A.

Starch Paste: Plasticity. C. Bergquist. *J. Phys. Chem.*, 1925, **29**, 1264-1265.

A method of determining the plasticity, i.e., setting and flow values, or yield and mobility of starch pastes with the Bingham plastometer is described. Using a capillary of 0·15 cm. in diameter and 2·6 cm. long, and a pressure of 850 gms. per sq. cm., the yield value for thick-boiling corn starch will vary between 250 and 400, and the mobility between 0·030 and 0·100. A starch having a mobility higher than 0·055 is stated to be not a first grade starch. —B.C.I.R.A.

Wheat Starch and Flour: Properties. G. G. Naudain. *Chem. Abs.*, 1925, **19**, 2245 (from *Amer. Food J.*, 1925, **20**, 250-251).

The paper covers a series of three main experiments—(1) A microscopic study of wheat starch to determine the effect of acids, bases, and salts on the swelling of the grains under various conditions of time and temperature; (2) a similar study on wheat flour and starch from wheat flour to determine the effect of reagents on viscosity; (3) a study of the imbibition of wheat flour and starch from wheat flour. (1) The number and size of starch grains of a wheat flour indicate the quality of the flour. The larger proportion of small starch grains indicates a good grade of flour. (2) The imbibitional study of the flour and starch from the flour indicates that the gluten is the more important factor. This is shown by the fact that the starch from a good flour has a lower value of imbibition than the starch from a poor flour. (3) The influence of the starch on the baking strength of flour might be indicated in the resistance of the starch grains, since it has been shown that the smaller starch grains are the more resistant to heat, moisture, and chemicals. —B.C.I.R.A.

Diastase: Constituents and Activity. V. Syniewski. *Bot. Zentr.*, 1925, **148**, 344 (from *Bull. intern. Acad. Polon. sc. et lettr., Cracovie; Cl. sc. math. et nat.*, Sér. A, 1924, 131-143).

α-Diastase helps to split those linkages in the starch molecule which join the maltose residues to the remainder of the molecule; by complete degradation maltose results together with a dextrin which gives a blue colouration with iodine but does not reduce Fehling solution. β-Diastase acts on the linkages connecting the glucose residues of the starch molecule. Barley contains only the α-diastase, which is mainly ab- or adsorbed by albuminous substances. In a complete proteolysis all the α-diastase is extracted from the grain; in a partial proteolysis during malting only a part of the α-diastase is extracted. β-Diastase is first formed in barley grain during malting and is completely extracted by water; during its formation a portion of the α-diastase disappears. No β-diastase is, however, formed by acting proteolytically on α-diastase. Malt contains no more diastatically active agents than does the raw barley concerned and may contain less. The total saccharifying power of the two diastases if they act in admixture on starch is greater than the sum of the saccharifying powers of the two diastases before their mixture.
—B.C.I.R.A.

Sodium Fluoride in Cold-sizing Materials. E. O. Rasser. *Chem. Abs.*, 1926, **20**, 295 (from *Kunststoffe*, 1925, **15**, 151).

NaF in cold-sizing materials serves two purposes; as a preserving agent and as an adhesive. Various formulæ are given for starch, dextrin, or casein products containing NaF. —B.L.R.A.

Artificial Silk Threads: Sizing. F. Schmidt. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 44-45.

In an article on the production of artificial silk effects on cotton grounds, the author discusses the possibility of sizing the mixed warps on the same machine. An experiment showed that when braked the artificial silk thread (120 den., untwisted) picked up more size than the cotton yarn, so trials were made, successfully, with the effect threads on one beam, run slack, and the cotton on a second beam. It is stated that the sized artificial silk was not so voluminous as the unsized but as such fabrics are

usually for piece dyeing this does not matter. Dyeing restores the volume. —B.C.I.R.A.

Starch: Hydrolysis. —. Haller and A. Hohman. *Melliand's Textilber.*, 1926, **7**, 239-242.

A viscosimetric method of determining the hydrolytic powers of a number of starch hydrolysing agents is described and applied to a study of various commercial preparations. The results show that enzyme preparations and oxidising agents differ very greatly in their effect. The viscosities of starch pastes treated with Aktivin, bleaching powder, or sodium perborate are higher than those of starch pastes treated with enzymes. The viscosities of all enzyme-treated starch pastes are very low, but Novo-Fermasol and Degoma D give particularly low results, approximating to the viscosity of water. Diastafor preparations differ very little in their effect. Biolase is slow in its action, being inferior to Aktivin. Using equivalent quantities of the various preparations Aktivin was found to have a greater hydrolysing power than bleaching powder, which was itself superior to sodium perborate. Traces of copper and nickel salts catalyse the Aktivin reaction. Experiments were made on the course of the hydrolysis of starch by the various reagents, as shown by the iodine colour of the products and their sugar content. Starches treated with Aktivin, bleaching powder, or sodium perborate gave zero sugar contents and those treated with enzyme preparations gave sugar contents varying from 4·83% for Novo-Fermasol to 31·5% for Degoma D. As the colour of the hydrolysed starch is important when the product is to be used in sizing and finishing a method of determining the degree of yellowing induced by the different preparations, based on a comparison of pastes of barium sulphate prepared with water and with the hydrolysed starch, is described. In this respect Aktivin is superior to all other hydrolytic reagents. —B.C.I.R.A.

Starches; Saponification Value of——. L. Rosenthaler. *Chem. Abs.*, 1926, **20**, 307 (from *Pharm. Zentralhalle*, 1925, **66**, p. 631).

The following values were obtained by heating 1 gram of the sample for one hour with 20 g. alcohol and 5 c.c. of 0·1 normal alcoholic alkali in connection with a reflux, thereupon titrating the unexpended alkali with 0·1 normal acid to a permanently colourless solution: wheat starch 5·1, rice 4·9, maranta 3·3, potato 4·7, corn 3·2, sago 5·3. It is believed these figures are true saponification values depending on the saponification of amylopectin, an ester of phosphoric acid. —L.I.R.A.

(C)—Weaving

Mercerised Cotton Yarn: Application. *Text. World*, 1926, **69**, 2751.

Two-fold mercerised cotton yarn is said to be the most suitable yarn for weaving with artificial silk. The similarity of their weaving properties reduces weaving difficulties to a minimum. For equivalent counts the yarns have nearly the same elasticity and require similar atmospheric conditions for weaving. —B.C.I.R.A.

Fast Reed Loom: Change of Speed. G. Schäfer. *Melliand's Textilber.*, 1926, **7**, 127-130.

An increase in the number of revolutions of fast reed power looms necessarily causes an increase in the strength of pick and therefore in the starting and finishing speeds of the shuttle. The errors of various proposals for counteracting this increased speed are indicated and a device is described for relieving the shuttle box swell which enables the speed of the loom to be increased without affecting other mechanism. —B.C.I.R.A.

Trouser Fabric: Weaving. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 130-131.

Directions and point diagrams are given for weaving cheap "worsted" and cotton trouser materials, corduroys, &c. The materials are all double weaves, the component warp and weft yarns being mainly cotton or cotton doubled with shoddy. Only in the better so-called worsted materials is worsted yarn used in the nap warp. —B.C.I.R.A.

Weaver's Knot: Tying. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 85-86.

The method is shown of making weavers' knots so that the thickening is distributed so far as possible uniformly round the yarn axis and not as a protrusion on one side, as in the hand knot. The Boyce knotting apparatus is illustrated. —B.C.I.R.A.

Auerbach Weft Changing Mechanism. Prof. Gräbner, Francke Werke, A.-G. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 46-47.

The new device is an improvement on the first and second Auerbach shuttle-changing mechanism which depend on the deflection by the shuttle of the walls of the shuttle box. In it a special cell is provided into which the exhausted shuttle enters and remains until after a new shuttle has arrived in the shuttle box. The shuttle is held in the cell because the latter forms a parallelogram when the two walls are swung forward. The backward swing of the walls releases the shuttle which falls downwards. The mechanism is explained in detail. —B.C.I.R.A.

Long-backed Shuttle: Advantages. *Leipzig. Monats. Text.-Ind.*, 1925, **40**, 199.

It is claimed that a shortened picker lengthens the working life of the picking parts and that a shuttle made with a lengthened gliding surface is more easily guided and less liable to fly off the race.
—B.C.I.R.A.

Picker Safety Device. Grossenhainer Webstuhl und Maschinenfabrik A.-G. *Leipzig. Monats. Text.-Ind.*, 1925, **40**, 199.

A safety device to prevent breakage of the picker parts consists essentially in mounting the picking arm on a pivot free to move along a groove in a tongue at right angles to the arm. Excessive pressure on the arm causes the pivot to slide in such a way that two springs are compressed and energy is supplied to the spring which draws the arm back into the normal position.
—B.C.I.R.A.

Artificial Silk Ribbons: Weaving. O. Both. *Kunstseide*, 1926, **8**, 63-66.

The applications of artificial silk in the ribbon industry are described and a pattern is furnished of a ribbon with a lustrous satin-like appearance. —B.C.I.R.A.

(D)—Knitting

Brinton Circular Knitting Machine. H. Brinton Co. *Text. World*, 1926, **69**, 1999.

A modified type of Brinton circular knitting machine designed to produce complicated patterned fabrics is described. The cylinder is similar to the regular sinker cylinder used in Brinton machines, except that it is higher to accommodate the new mechanism and the slots are cut deeper. Each needle slot is filled with a needle, a jack, and a presser. The butt of the jack can be depressed into the needle slot so that it does not ride over the jack cam and thus fails to raise the needle which consequently fails to knit on the particular feed. The needles which are to knit are selected by the tricks in the trick wheel in combination with the pressers in the needle slots.
—B.C.I.R.A.

Properties of Knitting Yarns. See Section 6.

(E)—Lacemaking and Embroidering

Hand-made Laces: History. G. Türksheim. *Melliand's Textilber.*, 1926, **7**, 307, 310-312, 417-420.

An account is given of the history, type and method of production of some real laces. Illustrations are provided of various sixteenth to eighteenth century productions. —B.C.I.R.A.

(F)—Subsequent Processes

Wetting Agent: Properties. —. Roestel. *Melliand's Textilber.*, 1926, **7**, 440.

A brief account is given of the chemical and physical properties essential to a good wetting, purifying and penetrating agent for textile materials. Tetracarnite possesses all the essential properties.
—B.C.I.R.A.

(G)—Fabrics

Tyre Fabrics: Construction. A. E. Jury. *Text. World*, 1926, **69**, 873-874.

A short outline of the development of the modern tyre fabric. The original tyre fabrics were of the square woven type, then cord fabrics were introduced and finally web fabrics in which weft threads are entirely eliminated. In making web fabrics, cords sufficient in number to make up the width of the fabric are run in parallel formation through a bath of latex, thence to a set of drying cylinders and when dry the cords are held firmly together by the rubber deposited from the latex.
—B.C.I.R.A.

Artificial Silk Fabrics: Thermal Properties. R. Schmehlik. *Melliand's Textilber.*, 1926, **7**, 317-318.

A study of photomicrographs of a woven artificial silk fabric shows that the yarn is not "spun," but is composed of a number of filaments lying loosely side by side. Moreover, the filaments are of considerable length so that there are no short ends and no outstanding surfaces to space the fabric from the body and provide an intermediate layer of air. Consequently the cloth has a cold feel. A photomicrograph of a knitted Vistra schappe fabric indicates that the cloth will have this cold feel to a less extent since the looped structure has a less flat surface which, assisted by the short ends of the Vistra fibre, spaces the fabric from the skin and provides for the intermediate layer of air. Artificial silk fabrics must, therefore, permit a rapid heat exchange between the heat of the body and of the surrounding air since the intermesh spaces are more or less open, especially in the woven fabrics. The cold feel and rapid heat exchange are traced to the solid structure of artificial silk as compared with the hollow structure of natural fibres and, in the absence of a hollow structure, care should be taken that the threads are not circular in cross section but flat, and that they are given a certain amount of twist, so that they approximate more closely in properties to cotton yarns. —B.C.I.R.A.

Fabrics: Nomenclature. O. Kuhn. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 247-249, 290-292, 382-385, 428-431; and 1926, **41**, 6-8.

The article forms a glossary of the known woven materials described under their

trade names and grouped under the headings (1) clothing materials, (2) linings, (3) silk materials, (4) heavy woollen materials, (5) plain cotton materials (shirtings, &c.), (6) coloured cotton materials (ginghams, &c.), (7) linen materials, (8) jute materials, (9) furnishing materials. In many cases weaving diagrams are given and the appropriate type of loom illustrated. —B.C.I.R.A.

Artificial Silk Trimmings. O. Both. *Kunstseide*, 1926, **8**, 111-112.

Some Barmen novelties comprising artificial silk braids, braided trimmings in which silk, wool, and cotton are used, and imitation fur borders are described. —B.C.I.R.A.

Cotton Filter Cloths: Properties and Application. L. Stein. *Chem. Ztg.*, 1926, **50**, 97-98, 110, 125-127.

A comprehensive discussion of the relevant properties of cotton fabrics and of filtration phenomena in relation to cotton filter cloths and their application. A plea is made for closer co-operation between the textile industry and the users of filter cloths. —B.C.I.R.A.

Patents

Loom with Knotting Attachment. Vereiningte Knoptepijindustrie System Banyai. F.P.593,920.

The loom consists of an ordinary loom and a movable carriage bearing knotting devices. These knotters are repeated at equal intervals, so that several knots are made at a time. After making the knots the carriage is displaced laterally until the whole range of knots is made. A reversing motion then stops the working of the knotter while the loom strikes and forms the desired number of weft threads for the ground. The knotting and weaving are made alternately and automatically. If only continuous knotting is desired the weaving can be stopped. —Bur. Text.

Sizing of Rayon. A. Schmid. F.P. 594,059.

The yarns are not dipped into the ordinary liquid size, but are bathed in a lather produced and formed by heating and boiling this liquid. —Bur. Text.

Loom Stop Motion. J. Catterall, Ingham Street, Bury. E.P.249,991.

If the picking strap breaks, the picking shaft makes a greater oscillation than usual, so that a finger thereon actuates a sliding rod against a spring to shift the belt-shipper handle to stopping position. If the opposite strap breaks a second rod is shifted in the opposite direction to act through arms on a spindle to shift the sliding rod to stop the machine. —B.C.I.R.A.

Knitting Machine Needle Bed. F. Billson, Stratford Square, Nottingham. E.P. 249,996.

A cylinder having detachable leaves or blades in the lower part and non-detachable tricks in a removable upper part, consists of a body to which are secured by screws a number of sections resting on a dovetail flange. Between each pair of sections there is a narrow blade forming the base of a trick and a wider blade forming the side wall of a trick. These parts are held in place by the flange and a ring. The sections are grooved out, the walls being undercut, and this space is filled in with other blades arranged alternately. Each section with the blades mounted thereon can be removed separately, for repair, &c., without disturbing other blades or sections. —B.C.I.R.A.

Loom Weft-replenishing Mechanism. British Northrop Loom Co. Ltd. and D. M. Hollins, Blackburn. E.P.250,024.

When weft replenishment is indicated, a shuttle feeler is, as usual, moved towards the lay and a movable cutting blade thereon co-operates with a fixed blade to cut the weft end extending to the selvage, and insert the cut end into the spring-pressed jaws of a thread block. An auxiliary clamping device is carried by, but spaced away from the shuttle feeler to grip the cut end of weft and retain it as the shuttle feeler returns towards the front to normal position, even though the cut weft end should be plucked out of the cutter owing to the contraction of the weft. The cut end is retained by the clamping device until it is dealt with by the temple cutter, or by the operative. The clamping device may comprise a plate with a lateral part upturned to co-operate with an off-set portion of a plate secured to the movable cutter blade. —B.C.I.R.A.

Soft Collar Fabric: Weaving. A. H. McCarrel, Washington, U.S.A. E.P. 250,043.

A flat, level fabric for use in making soft or semi-soft folding collars is woven with curved wefts and straight warps, the parts corresponding to the fold lines of the collars being woven to render them more flexible, but not weaker than the rest of the fabric. Two suitable weaves, respectively for a double and a triple fabric, are shown. —B.C.I.R.A.

Curved Reed Loom. A. H. McCarrel, Washington, U.S.A. E.P.250,044.

In order to weave a flat fabric having curved wefts for use in making soft or semi-soft turned-down collars, a loom is provided with a curved reed, comprising dents held between upper and lower ribs secured in a curved lay and reed cap. In the form shown, the lay, reed, and shuttle boxes are curved so that the shuttle travels in an

arcuate path. The shuttle is shaped on its rear side to fit the front side of the shuttle box back, and the picking spindles are also curved. —B.C.I.R.A.

Loom Back-bearer Control Mechanism. F. Volech, Vrchlabi, Czecho-Slovakia. E.P.250,084.

In looms for weaving handkerchiefs, &c., in which the shedding motion is stopped to allow several picks to be inserted in a single shed, the vibration of the back-bearer is effected by a lever controlled by a cam participating in the movement of the shedding eccentrics, so that the vibration of the back-bearer and the shedding-motion are stopped at the same time. The pivoted back-bearer has an arm connected by a pin and slot device to a lever resting on the cam mounted on the picking tappet shaft carrying the shedding eccentrics. The shaft is made in two parts adapted to be unclutched when the shedding is to be arrested. The lever may be dispensed with, the arm engaging the cam directly. —B.C.I.R.A.

Shuttle Peg. A. Cass, Swinton, and J. Robinson, Eccles, Lancs. E.P.250,276.

A pivoted shuttle peg having a slotted head through which passes a spring tongue to engage a spring, tapers in both directions from a point about one-third the length of the peg from the slotted head. —B.C.I.R.A.

Loom Dobby Mechanism. J. W. Kellett, Preston, and J. K. Smith, Holbrooks, near Coventry. E.P.250,338.

A feeler lever is thinned down where it engages the chain pegs, either by milling or in casting. A double-width peg is used to operate two adjacent levers, or a single-width lop-sided peg when only one lever is to be operated. —B.C.I.R.A.

Pile-fabric Pile Wires. W. H. Raistrick, Shipley, Yorkshire. E.P.250,433.

Longitudinal pile wires are formed from a single length of wire which passes in the direction of the warp, round a back frame, round the shank of a wire-holder, back round the frame and again in the direction of the warp. The holder also acts as a guide for rotary cutters arranged above the wires; the cutters may alternatively be spaced by distance washers. —B.C.I.R.A.

Loom Shedding Motion. Morton Sundour Fabrics, Ltd., and J. Morton, Carlisle, and J. B. Webster, Lancaster. E.P. 250,447.

The warp threads are divided, some being passed through the eyes of additional healds, whilst the others are passed through the eyes of ordinary healds and are shed in the usual manner. After a pick, the additional healds, which are made in sections, are shed so that the warp threads carried by them are raised and lowered respectively gradually and progressively in the wake of the shuttle, so that the weft is caused to assume a sinuous form before it is beaten up, and the warp threads are properly covered. Levers which are operated in succession by grooved cams are connected directly to the additional healds by cords and are connected also to the healds by other cords passing over pulleys, whereby the warps are raised and lowered in succession. The grooved cams are mounted on a shaft driven by chain gearing from a shaft geared to the main shaft. The additional healds are prevented from swinging by being connected below by guide ropes passing over pulleys. The apparatus may be used for weaving the backing of carpets, &c. —B.C.I.R.A.

Warp Beaming Machine Driving Drum. J. Brandwood, Birkdale, T. Brandwood, Bury, and J. Brandwood, Waban, Mass., U.S.A. E.P.250,645.

In the winding of warp on a beam by means of a friction driving roller and wherein the beam and roller are held out of contact during the early stages of the winding by means of discs or drums which transmit the drive during such early stages, the drum is made of approximately the same size as the beam and the disc of the same size as or slightly larger than the roller and spaced therefrom to accommodate the beam flange. —B.C.I.R.A.

Knitting Machine Streaked Patterning Mechanism. Dresdner Strickmaschinenfabrik Irmscher & Witte, A.-G., and M. Kuehne, Dresden, Germany. E.P. 250,796.

For producing streaked patterns the needles are selected by the direct action of pattern plates on the lower ends. The needles so acted on are pushed down, between selections, by rollers or discs attached to a slide and acting on the butts. The perforations of the pattern plates can be covered over by movable clips placed under the needles to be selected. —B.C.I.R.A.

Straight-bar Knitting Machine Plating Mechanism. H. W. Scothon, T. H. Wilde, and E. W. Scothon, Mansfield, Notts. E.P.250,831.

The bar carrying the plating yarn guides is variably traversed by means of striker or hammer mechanism controlled by pattern chain studs. The mechanism is described. —B.C.I.R.A.

Weft Replenishing Mechanism. Soc. Anon. G. Bassetti, Milan, Italy. E.P.250,934.

In looms provided with automatic spool-changing mechanism, the shuttle box at the spool-changing end of the lay or both shuttle boxes are stationary and are separated from the oscillating part of the

lay. Upon indication for weft replenishment, a pin is moved by link and lever devices from the weft-feeler into engagement with a groove in a clutch member splined on a rotating shaft. A cam on the clutch member is thereby caused to operate the transferrer which is provided with a give-way device which operates when undue resistance is encountered. The weft ends from the cops in the magazine are secured to holding means on a belt. The shuttle is positioned in the shuttle box by cam-operated link and lever devices. In order to prevent damage to the shuttle box due to an improperly positioned shuttle, a portion of the front of the box is hinged and controlled by a spring. The movable portion of the lay is mounted on swords linked to levers and is operated by cams engaging bowls on the swords and levers, the cams being designed to cause the lay to dwell whilst the shuttle is in the shuttle box. The stop rod is made in three parts, arms on the part for engaging the frogs being controlled by cranked portions of the swell-controlled rods. —B.C.I.R.A.

Pile Fabric Loom Pile Wire Mechanism: Driving. Schoeller Geb., Düren, Germany. E.P.250,941.

The pile wire actuating mechanism is driven by an auxiliary motor which may be an electro-motor and acts for this purpose either alone or in conjunction with the motor driving the other parts of the loom. —B.C.I.R.A.

Openwork Fabric: Weaving. M. Dehové, Paris. E.P.250,992.

A fabric is woven with patches containing warp and weft threads, patches containing warp threads only, patches containing weft threads only and spaces containing no threads. After inserting four picks a space equivalent to four picks may be left free of weft, but floating threads operated by eyelets and shogging bars are crossed under the warp threads across the space. The spaces of the fabric may be filled by embroidery threads passed through alternate spaces or diagonally, or alternatively, or in addition, an ornamentation may be applied by means of a rib stitch or by burls or knots or over-edge scolloping stitches. —B.C.I.R.A.

Lace Machine Weft-inserting Mechanism. F. Noyer and P. Pilard, Calais, France. E.P.251,022.

A vertically sliding weft carrier is mounted on a reciprocating bar running on rollers and is operated by linkwork from a cam. The weft is drawn off by a wheel suspended by links from the reciprocating bar and from a slide. The friction of the slide on the bar on which it slides causes the wheel to press on one or other of two bars according to the way the reciprocating bar is travelling, the wheel being thus always turned in the same direction. The wheel may be held by a spring against the top bar and the spring may be pulled away by a cam acting through linkwork when the bar is travelling in the opposite direction, so that the wheel drops on the lower bar. The reciprocating bar may be reciprocated by rack and pinion gear driven by a cam. The apparatus may be duplicated. Mechanism for gripping and retaining the weft below the carriage is described. —B.C.I.R.A.

Knitting Machine Pattern Wheel Setting Device. Mellor, Bromley & Co. Ltd., Leicester, and J. G. Raphael, London. E.P.251,450.

In order quickly to reset bits mounted in radial grooves a templet or setting device, which may be incorporated in the pattern wheel is employed. The device consists of a ring notched on the outer or the inner edge in accordance with the pattern desired. When it is necessary to reset the wheel in order that the knitting machine needles may be acted on in a different sequence the clamp plates are slackened and the bits are moved by hand outwards or inwards as necessary. The device is then placed on the wheel in the plane of the bits, which are moved inwards or outwards to abut on the notched head of the templet, whereupon the clamp plates may be tightened up and the templet removed. —B.C.I.R.A.

Loom Shedding Motion and Warp Threads: Tensioning. G. J. Seckel, Overijsel, Holland. E.P.251,467.

The tension of the warp threads immediately adjacent the wires of the reed, is arranged to be less than that of the other warp threads at the beat-up, whereby a reed with wider splits may be used without causing reed marks. For this purpose the heald leaves controlling the reed warp threads are operated by levers and eccentrics which act later than the eccentrics and levers for the heald leaves for the other warp threads. Alternatively, or in addition, the reed warp threads may pass over a back bearer operated by a lever and eccentric so as to be slackened at the beat-up and afterwards tightened, the other warp threads passing over a fixed back bearer or an ordinary movable back bearer. —B.C.I.R.A.

Loom Picker. P. Pennartz, Lille, France. E.P.251,532.

A metal picker is provided with a nose portion of buffalo hide or the like having a tongue and groove connection with it. Both the picker and the nose-portion have narrow downward extensions to engage in the picker guide groove. —B.C.I.R.A.

Hand Threaded Shuttle. F. Crossley, Radcliffe, Lancs. E.P.251,556.

To thread the shuttle, the weft is passed along a slot and round a stud in an offset recess. The weft is then pulled through a side opening, thus disengaging from the stud, and is passed through a slot into the shuttle eye. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Preparatory Processes—

250,020. W. A. Beedham. Jacquard card punching machine.

Weaving—

250,290. G. Hodgson, Ltd., and J. Elsworth. Looms: drop-box construction.

250,365. W. C. Robinson. Loose-reed loom: reed case device.

Knitting—

251,112. G. Beresford and W. E. Woodford. Multiple feeder machines: Cross-tuck device.

251,446. I. L. Berridge & Co. and others. Circular machines: patterning feeder.

Fabrics—

250,369. W. R. McMurray. Fabric or sheet strengthening device.

250,981. Duratex Corporation. Pile fabric construction process.

251,038. J. A. Sackville. Waterproofing tracing cloth.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming

Emulsifying Oils: Preparation. Gen. Matsumoto. *Chem. Abs.*, 1924, **18**, 1549 (from *Rept. Imp. Ind. Lab. Osaka*, 1923, **4**, 1-35).

Oils of herring, cod, sardine, soy bean, castor, and cottonseed were sulphonated. To these, various amounts of oleic acid, spindle, and machine oils were added to see under what conditions the best emulsifying oils are obtained. Over 30 tables are given in which the physical characteristics of the original, sulphonated, and emulsifying oils are shown. The conclusions are—A large quantity of fatty oil or mineral oil is miscible with sulphonated herring oil, but not with sulphonated soy bean oil. Oleic acid or spindle oil can be used with sulphonated oils as emulsifying agents. Sodium or potassium hydroxide or ammonia can be used, but the choice of the alkali should depend on the type of sulphonated oil and the purpose of the emulsifying oil to be prepared. The emulsifying oil containing mineral oils stays liquid all through the winter, but the other often solidifies. The amounts of fatty oils and alkali to be added depend on the conditions of sulphonation and other factors. —B.C.I.R.A.

Neppy Cotton Cloth: Scouring. *Melliand's Textilber.*, 1926, **7**, 476.

The following method is described for removing pieces of seed coat from woven cotton fabrics. The cloth is passed once through a caustic soda bath of 3-4° Bé., containing a good wetting agent, is squeezed out and allowed to remain, covered to prevent drying out, for 24 hours. At the end of this time the pieces of seed coat appear increased in size and can easily be removed by rinsing. Resistant pieces may require 48 hours' standing. The cloth is then washed and immediately submitted to the usual boiling and bleaching processes, the time of boiling being considerably reduced. No desizing is required after this treatment and twill fabrics have a higher lustre and purer appearance, especially in pale shades. —B.C.I.R.A.

Wool Fat Extraction. E. O. Rasser. *J. Soc. Dyers and Col.*, 1925, **41**, 288 (from *Chem. Ztg.*, 1925, **49**, 73).

An extraction process is described in which "mechanical" stirring is avoided. The extractors are large heat-insulating horizontal vessels, in which the wool is placed in several layers on iron frames. The vessels are hermetically sealed and the solvent, generally trichlorethylene, is pumped in and heated by steam pipes. Air is pumped in at the bottom of the extractor to keep the solvent agitated and thus the wool is treated uniformly without a risk of felting. The solvent is removed after a few hours and the wool rinsed in clean water. To remove the solvent completely the vessel is alternately evacuated and refilled with hot air.

—B.R.A.W. & W.I.

(C)—Washing

Effect of Glue on Wool. *Chem. Abs.*, 1926, **20**, 507 (from *Tiba*, 1925, **3**, 1021 and 1149).

Brief review of various theories of detergent action. Properties and effect of glue on wool are given. Felting is accelerated by substitution of glue for NaOH in soap. Starch paste and glucose increase the detergent properties of soap. —B.L.R.A.

(G)—Bleaching

Bleaching with Liquid Chlorine; Equipment for. *Text. Col.*, 1926, **48**, 477-480.

Suitable apparatus for preparing bleach liquors on a large scale by passing chlorine (from liquid chlorine) into aqueous solutions containing sodium carbonate or sodium carbonate and caustic soda is described. Bleaching solutions containing

no caustic alkali should be used within 24 hours of their preparation, whereas those containing caustic alkali are stable for 3-4 days. —A.J.H.

Aktivin and Perborate. B. Waeser. *Chem. Abs.*, 1926, **20**, 801 (from *Chem. Zeitg.*, 1925, **49**, 853).

Aktivin acts more quickly upon textile fibres than perborate, and is more injurious to org. colours. Aktivin is not sufficient for a complete bleach, and shows no advantage over perborate. It gives *p*-toluene sulphonamide as the by-product. Addition of 1% aktivin or perborate to a starch suspension with steam-stirring for 10 mins. yields a soluble starch of a composition between starch and dextrin. —B.L.R.A.

Peroxide Bleaching Liquors: Application. T. D. Ainslie. *Amer. Dyestuff Rep.*, 1926, **15**, 203-207.

A general article on the use of sodium peroxide, hydrogen peroxide, and sodium perborate in the bleaching of textile materials. Solozone and Albone are respectively commercial sodium and hydrogen peroxides. —B.C.I.R.A.

Chlorinated Lime; Deterioration of Commercially Packed——. C. C. McDonnell and L. Hart. *Chem. Abs.*, 1926, **20**, 1305 (from *U.S. Dept. Agric.*, 1926, Bull. No. 1389, pp. 1-19).

The available chlorine in samples of bleaching powder packed in containers of the usual commercial type as a rule decreases fairly regularly during storage on account of the conversion of the chlorine into calcium chloride. No marked difference was noted in the rate of deterioration between samples manufactured and packed in winter and in summer, but the loss of available chlorine was greater in warm than in cold weather, the average loss for the hottest months of the year being 1·44% per month and for the coldest months 0·61%. A comparison of samples stored in glass bottles in the light with those stored in the dark indicates that light rays slightly accelerate the loss of available chlorine. —L.I.R.A.

Bleaching of Wool Grease. I. Lifschutz. *J. Soc. Chem. Ind.*, 1926, **45**, B500 (from *Chem. Ztg.*, 1926, **50**, 245-246).

The bleaching of wool grease on exposure to air and light is due to oxidation of the products of hydrolysis (alcohols and fatty acids) of the esters, the undecomposed esters not being bleached. This principle has been applied on a large scale in conjunction with the process described in G.P. 324,667 (B, 1920, 790a) for bleaching wool grease. The sodium soap of the completely saponified grease was pressed into thin flakes and exposed to sunlight in glass boxes. These dark brown soap flakes were bleached to a pale yellow after three to four days' exposure. When the grease was only partly saponified with lime the results were inferior. The process is stated to be applicable on a large scale to all grades of wool grease, and the sodium soaps may be used for many industrial purposes. They are particularly suitable as additions to toilet soaps, as in virtue of the nature of the unsaponifiable matter present the lathering and detergent properties of the soap are improved. —B.R.A.W. & W.I.

Mohr Bleaching Process: Efficiency. M. Freiberger. *Melliand's Textilber.*, 1926, **7**, 148 and 226-227.

The Mohr bleaching process is compared unfavourably with the usual methods of bleaching. A part of the pectins and proteins is lost by oxidation and since fats and waxes which hinder wetting and penetration are left in the cotton a considerable excess of oxidising agent must be used so that a considerable quantity of oxycellulose is formed and partially dissolved by the peroxide lye. The greater weight of the bleached goods claimed for the Mohr process is due to decolorised impurities remaining in the fabric, which more than compensate for the loss of cellulose. This loss is detected by the decreased strength of the bleached cloth as compared with the grey cloth. The fat remaining in cloth bleached by the Mohr process affords some protection against rapid yellowing, but soaping in laundering gradually removes the fat and yellowing is greater than in cloth bleached by full bleach methods. In experiments in which parts of the same cloth were bleached respectively by the Mohr and Thies-Herzig processes, the Mohr bleached cloth after printing and steaming was very yellow, and in dyeing, the shades were patchy. Similar results were found after certain improvements had been made in the Mohr process. Technically, the process is more expensive than the usual processes and the method of packing the goods and bleaching different kinds of cloth together is deprecated. —B.C.I.R.A.

Viscose Artificial Silk Waste: Bleaching. H. Hillringhaus. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 61-62.

Most viscose silk waste occurs in the course of manufacture before the sulphur-removal stage. For treating the waste a bath containing 10-12 gr. of sodium sulphide per litre at 45-50° is recommended; the waste is then washed and bleached with bleaching powder or sodium hypochlorite solution. After bleaching, the waste is again washed and may be dyed. Long standing in water does not rot viscose yarn. Satisfactory bleaches have been obtained with 120 den. yarns of 19 filaments each of 6·3 den. and others. —B.C.I.R.A.

Commercial Test for Hydrogen Peroxide. See Section 6.

Development of Bleaching Plant. See Section 4I.

(I)—Dyeing

Warp Beam: Dyeing. J. W. Eich. *Amer. Dyestuff Rep.* (*Proc. Amer. Assoc. Text. Chem. and Col.*), 1923, **12**, 55-65.

A report of an open discussion on pressure machine dyeing, with particular reference to beam dyeing. —B.C.I.R.A.

Dyes: Fastness to Light. W. D. Bancroft. *Amer. Dyestuff Rep.*, 1923, **12**, 935, &c.

A general discussion on the fastness of dyes to light. Statements from the literature illustrate the lack of understanding of the subject and the necessity for investigation. Numerous suggestions for experiments are made. —B.C.I.R.A.

Hydrogen Reduction Dye Vat: Application. F. F. Warshaw. *Amer. Dyestuffs Rep.*, 1924, **13**, 163-165.

In laboratory experiments with vat dyes the author finds that partial preliminary reduction with hydrogen before treating with hydrosulphite effects a saving in hydrosulphite of 66% for a dyeing effect fully as bright and clear though lacking the body and strength of one dyed with the use of hydrosulphite alone. The two vats and similar keeping properties. The dye mainly used in the experiments was Anthrene Yellow G. —B.C.I.R.A.

Artificial Silk: Vat Dyeing. M. T. Johnson. *Amer. Dyestuff Rep.*, 1926, **15**, 162.

The following mixture is recommended for adding to the vat before the dye—4% glue, 2% sulphonated oil, 3% sodium formaldehyde sulphoxylate, 2% caustic soda, and 2% hydrosulphite. The dye is added and the skeins dyed cold. The oxidation bath is heated to 130-140° F., using sodium perborate as oxidising agent. The soap bath is heated to 130-140° F. —B.C.I.R.A.

Chain Warps: Dyeing. C. R. Ephland. *Amer. Dyestuff Rep.*, 1926, **15**, 165.

The author discusses the difficulties met with in chain warp dyeing, namely, that of obtaining the right dye combination and of keeping the dye in solution during the 2-3 hour run. —B.C.I.R.A.

Franklin Loose Cotton Dyeing Machine. G. T. Metcalf. *Amer. Dyestuff Rep.*, 1926, **15**, 186-188.

All operations, including wetting out, dyeing and rinsing, are done continuously in a steam-tight kier, and after the dyeing is completed the dye liquor is drawn off through a discharge pipe before the stock is removed. Free steam is thus entirely eliminated. The machine effects very even dyeing without causing either matting or tendering of the stock which, after loading, is not disturbed until the dyed product is removed in a solid cheese. —B.C.I.R.A.

Celanese: Dyeing. R. G. Dort. *Amer. Dyestuff Rep.*, 1926, **15**, 258-264.

A brief outline of the dyeing methods used. Particular attention is given to cross dyeing, the control of lustre, particularly the production of a ciré effect by calendering at a fairly high temperature, and simile printing in which the fabric is first delustred and is then locally re-lustred in the required design by passing it through printing rollers. —B.C.I.R.A.

Cellulose Acetate Silk: Dyeing. C. E. Mullin. *Amer. Dyestuff Rep.*, 1925, **14**, 173; 1926, **15**, 285.

Two series of articles comprising 25 parts and a collective index. A comprehensive review of the subject. —B.C.I.R.A.

Fast Tan Striped Awning Cloth: Dyeing. F. A. Alter. *Cotton* (U.S.), 1926, **90**, 430.

A process for the production of fast tan awning stripes is described and a continuous five-compartment machine, which is the best type of machine for the purpose, is shown. —B.C.I.R.A.

Titanium and its Uses for Textile Treatment. W. B. Nanson. *Text. Col.*, 1926, **48**, 463-465, 483.

The uses of titanium salts as stripping agents and mordants are discussed. —A.J.H.

Sulphur Black: Dyeing. H. C. Roberts. *Text. World*, 1926, **69**, 1987-1989.

Greater depth of shade and fastness to washing are obtained when cotton goods are dyed with sulphur black by a single bath method rather than in a standing bath. The dyeing process employed is described and directions are given for treating goods exhibiting signs of bronziness. —B.C.I.R.A.

Union Fabrics: Dyeing. L. J. Matos. *Text. World*, 1926, **69**, 1991-1993.

Directions are given for dyeing union fabrics of cotton warp and wool, together with suitable dye recipes. The preliminary scouring process, the means to be taken to prevent uneven shades, and the modification of the method to produce light shades are discussed. —B.C.I.R.A.

Jigger Dyeing Machine. H. W. Butterworth & Sons Co. *Text. World*, 1926, **69**, 2349.

The jigger is intended for light work. It has a soapstone box, the joints of which are filled with cement. All the interior fittings are of monel metal. The beam rollers are 6½ to 7 in. rubber covered and run on ball bearings. The immersion rollers run on graphite rubber bearings. Immersion rollers of brass, copper, wood, rubber, or steel can be supplied. —B.C.I.R.A.

Artificial Silk: Dyeing. G. Rudolph. *Kunstseide*, 1926, **8**, 59-60.

A short general article dealing with dyestuffs for viscose and cuprammonium silk. The dyeing properties of basic dyes, substantive dyes after-treated with formaldehyde, diazo, sulphur, and vat dyes are discussed. —B.C.I.R.A.

Dyeing and Bleaching. G. Ulmann. *Leipzig. Monats. Text.-Ind.*, 1925, **40**, 169-173.

A general article dealing with the development of mechanical dyeing and bleaching plant and methods consequent upon the establishment and growth of the synthetic dyestuff industry —B.C.I.R.A.

Sulphite Cellulose Mordants: Application. W. Bruckhaus. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 63-64.

The article describes the tanning and mordanting properties of sulphite cellulose lyes. A mixture consisting of 700 kg. of ground tannin mixed with 400 kg. of the dried substance obtained from sulphite cellulose lyes is recommended for use as a mordant on silk, artificial silk and cotton. —B.C.I.R.A.

Viscose Artificial Silk: Dyeing. H. Hillringhaus. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 64-65.

The author describes his method of dyeing viscose silk with substantive dyes and explains how colours may be matched more nearly; he emphasises the importance of careful sulphur removal. With vat dyes he recommends dyeing at night, hanging the material in the air overnight, and then washing, &c. —B.C.I.R.A.

Dyeing. A. Lottermoser. *Melliand's Textilber.*, 1926, **7**, 146-147, 225-226.

A short review of the present state of knowledge of the physical-chemical nature of dyes and fibres and of theories of dyeing. —B.C.I.R.A.

Dyebath: Effect of Dye Dispersion; and Tetracarnite: Application. R. Roestel. *Melliand's Textilber.*, 1926, **7**, 228-230.

Experiments on the dyeing of readily and difficultly penetated animal and vegetable fibres and artificial silk with direct, vat, sulphur, alizarin, acid, and basic dyes, including difficultly soluble and insoluble dyestuff bases, show that for the production of good dyeings and the exhaustion of the dyebath, the dye must be present in a state of maximum dispersion. This condition can be obtained by adding a suitable solvent for the dye or reduced dye to the dyebath, and since wetting the fabric to be dyed facilitates dyeing, the solvent should also be a wetting agent for the fibre and, where possible, assist in freeing the fibre from impurities, especially fats. These conditions are fulfilled by Tetracarnite, with which the experiments were made. —B.C.I.R.A.

Loose Cotton Dyeing Apparatus. K. Reik. *Melliand's Textilber.*, 1926, **7**, 234-236.

Apparatus for dyeing loose cotton and sliver, comprising a hollow cylindrical vessel in which the material is packed and in which it can be centrifuged after dyeing, a pressing device to facilitate packing, an apparatus for developing cross-wound spools, a closed warp beam dyeing apparatus, and a warp beam centrifuge are described. The apparatus is discussed in relation to the application of the Naphthol AS colours, but can be used for all classes of dyes; it is the product of the Obermaier Co. —B.C.I.R.A.

Combined Naphthol Dyes: Fastness to Light. L. Löchner. *Melliand's Textil.*, 1926, **7**, 243-244.

Experiments are described in which a bleached calico was dyed with Naphthol AS +Fast Red GL base, Naphthol AS-SW+ Fast Red KB base, or Naphthol AS-RL +Fast Red RL base, and submitted to various after-treatments at different temperatures. The samples were then exposed to sunlight for a little over two months. The results show that the degree of fastness to light depends on the temperature of the after-treatment and increases as the temperature increases. The extent to which the after-treatment influences fastness to light varies with the different naphthol combinations. —B.C.I.R.A.

Ostwald Colour Theory: Application. E. Klahre. *Melliand's Textilber.*, 1926, **7**, 345-349.

A discussion of the practical application of the Ostwald colour theory and an explanation of the method adopted by the Deutsche Werkstelle für Farbkunde in the development of colour standards on cotton. —B.C.I.R.A.

"Tingor W" Artificial Silk Dyeing Machine. P. Weyrich. *Melliand's Textilber.*, 1926, **7**, 356-357.

The pumps, mixing chamber and circulating system are collected together in the centre of the machine. The hanks of artificial silk are carried in a special movable waggon which is attached to the central part of the machine by a special device. The carriers are made in different sizes and are lined with a chemically resistant metal plate of a special alloy which is easily cleansed so that the use of colours of widely varying shades is facilitated. One central part with three carrier parts of different sizes enables batches of 5 to 50 kilograms to be dyed with widely varying colours and in different degrees of fastness. Mercerised cotton and, with some modifications in the carrier apparatus, yarn in spool form could be dyed in this machine. —B.C.I.R.A.

Nitrosophenol Dyes: Application. P. Wengraf. *Melliand's Textilber.*, 1926, **7**, 447-448.

Experiments are described in which a fabric treated with a naphthol such as β-naphthol was subsequently printed with a paste containing acetic acid-starch-tragcanth thickening, glycerol, sodium nitrite, and either iron, nickel, aluminium, zinc, or chromium acetate. The nitrosophenol dye was formed only after passing for 5 mins. through an air-free Mather-Platt steamer and only the iron, nickel, and chromium salts gave shades of practical value. Increasing the quantity of the metal salt deepened the shade to a certain point, after which further additions were without effect. These nitroso colours can fix basic colours to a limited extent so that the iron colours can be improved with methyl violet and the nickel and chromium colours with Rhodamine, giving shades which are brighter and faster to soap. They can also be discharged with the formaldehyde-sulphoxylates.
—B.C.I.R.A.

Dyeing. S. Marian. *Melliand's Textilber.*, 1926, **7**, 458-461.

A report of a lecture in which the dyeing process is considered as a contest between the liquid and solid phases for the dyestuff particles. The more thoroughly the dyestuff particles can be averted from the liquid phase and directed to the solid phase the fuller and faster will be the dyeing. The deciding factor is the magnitude and action of the electrostatic valencies of the participating materials. —B.C.I.R.A.

Chromium Salts: Photochemistry; and Dyes: Photomicrography. J. Plotnikow and M. Karschulin. *Z. Physik.*, 1926, **36**, 277-287.

A series of spectrographs of dichromate at different concentrations and layer thicknesses indicates that light adsorption begins at about 595 mμ in the yellow and extends with increasing intensity up to the extreme limit of the ultraviolet. In the same way, using a light source of 100,000 Hefner candles spectrographs of "photochemical absorption" were taken on a dichromate collodion plate; these show that photochemical absorption also begins at 595 mμ in the yellow, reaches a maximum at about 500 mμ in the green and then slowly decreases up to about 240 mμ. Ultramicroscopic observations have been made on a number of dyes and photomicrographs taken. —B.C.I.R.A.

Dye Mixtures: Analysis. See Section 6

(J)—Printing

Elastic: Printing; and Bakelite and Pigment Printing Pastes: Application. *Text. World*, 1926, **69**, 2757.

A blue or scarlet which is fast to washing without an after-treatment or fixation is printed by employing pigments and using as a carrier and fixing agent combined a solution of nitrocellulose in alcohol or ether, cellulose acetate in acetone, or bakelite in acetone. All three solutions give fast colours, but the bakelite solution is fastest. The pigments must be used either as dry powders or alcoholic pastes. Drying on cylinders or in a warm room is sufficient to fix the pigments. An alternative possibility is the use of the "Gallopont" colours which are soluble in formic acid and do not require steaming, though they are usually fixed and washed.
—B.C.I.R.A.

Resorcinol in Printing Silk. *Silk* (N.Y.), 1925, **18**, No. 11, p. 41 (from *Rev. gen. Mat. Col.*, 1925, **29**, 224).

This chemical is a solvent of basic dyes and their lakes formed with tannic acid and various inorganic salts. The resultant shades are much deeper. In contact with acetyl cellulose some de-acetylation takes place. —F.G.P.

Vat Dyes: Application. F. Whittaker. *Amer. Dyestuff Rep.* (*Proc. Amer. Assoc. Text. Chem. and Col.*), 1923, **12**, 13-16.

A practical lecture on the application of vat colours in calico printing. Reference is made to the efficiency of a mixture of sodium silicate and caustic soda as a substitute for potassium carbonate.
—B.C.I.R.A.

White and Coloured Lead Reserves under Vat Blue: Printing. H. Pomeranz. *Leipzig Monats. Text.-Ind.*, 1926, **41**, 111.

Lead-containing reserves for Vat Blue are made by mixing copper sulphate, lead nitrate, and lead acetate in which about half the last two are converted into lead sulphate by means of copper sulphate and copper nitrate-acetate. Care must be taken to print with an even thickness of the paste. The lead sulphate imparts to the reserved places (usually unbleached) a very good white and gives with chrome orange colourings of desired brilliance.
—B.C.I.R.A.

Calico Printing. K. Reinking. *Melliand's Textilber.*, 1926, **7**, 230-231.

The first mention of calico printing in the literature is in Herodotus' account of the campaigns of Cyrus on the Caspian Sea. The leaves of a type of tree growing in the forests were said to be triturated and mixed with water to prepare a dye which was used for painting animal figures on clothing. The figures were as durable as if woven into the material and lasted as long as the cloth itself. The simplicity of fixation would appear to indicate that the dye was indigo, if "shrub" could be substituted for "tree." Reference is also made to early

methods of printing bark tissue fabric in the South Sea Islands and among the African negroes, and to a simple method of obtaining fast prints by printing a wet fabric with a printing mould which had been blackened in a sooty flame.

—B.C.I.R.A.

Cellulose Acetate Silk: Printing. A. Schneevoigt. *Melliand's Textilber.*, 1926, **7**, 354.

A short general article on methods and dyes used for printing cellulose acetate silk.

—B.C.I.R.A.

(K)—Finishing

Fabrics: Mildew-proofing. D. G. Woolf. *Text. World*, 1926, **69**, 2869.

Salts of the rare earth metals (patented as "Vivatex" salts) are claimed to render cloth mildew-proof and waterproof. The Pease Laboratories report that a sample of olive drab treated by the "Vivatex" process remained mildew-proof for two years. —B.C.I.R.A.

Finishing Machinery: Corrosion. W. W. Chase. *Text. World*, 1926, **69**, 1513.

The corrosive action on building materials, equipment, pipes, drains, &c., of chemical substances in common use in bleaching, mercerising, dyeing, and finishing is discussed and suitable materials for use in the presence of given chemical substances are indicated. —B.C.I.R.A.

Viscose: Application. W. B. Nanson. *Text. World*, 1926, **69**, 585.

Viscose is an efficient medium for filling certain classes of cotton goods. It is prepared in an air-tight barrel and is applied on an ordinary single-colour printing machine fitted with the regular padding box to hold the colour. The furnishing roller is steel and the filling is printed on the cloth either by a smooth roller or by a slashed or pin-engraved roller. The filled and dried cloth is subsequently passed through an aniline ageing box, which permanently fixed the viscose on the fibre. It can then be dyed. The process is more expensive than starching or other filling methods but it is better and the filling will stay in permanently. Heavy goods such as tarpaulins may be waterproofed either with or without the aid of casein or other adhesive. Artificial leathers of all kinds may be made with this filling and it is also used for curtains and trunk linings.

—B.C.I.R.A.

Napping Coloured Fabrics. H. D. Martin. *Text. Col.*, 1926, **48**, 457-458.

A general review of the chief features concerning the napping of such materials as flannels, blankets, knitted sports' wear, and dress goods. —A.J.H.

Philanisation of Cotton. C. Schwartz. *Chem. Abs.*, 1926, **20**, 507 (from *Tiba*, 1925, **3**, 1129).

By the action of conc. HNO_3 (concn. not stated) at 0° C. on cotton fibres in the presence of starch or similar substance (i.e., on unbleached cotton) a decidedly woolly effect is produced, which it is extremely hard to obtain with bleached cotton.

—B.L.R.A.

Cotton Cloth: Finishing. O. Gaumnitz. *Melliand's Textilber.*, 1926, **7**, 237-239.

The successful finishing of cotton cloth depends to such an extent on the treatment of the cloth in sizing and weaving that a good understanding between weavers and finishers is essential. The effect in finishing of the principal sizing ingredients is discussed and it is pointed out that grey cloth weavers frequently use paraffin and trade compounds said to assist weaving, without the knowledge of the management. Two such compounds, "Fadenfest" and "Zanite," were examined and found to be entirely unsaponifiable and largely composed of paraffin. Such compounds are of great assistance in coloured weaving but this reservation is not made by the makers of the compounds. Magnesium chloride in relation to singeing, and rust and oil stains are also discussed. —B.C.I.R.A.

Aktivin: Application. R. Feibelmann. *Melliand's Textilber.*, 1926, **7**, 144-146.

The use of Aktivin in the preparation of starch mixtures for finishing is discussed, with particular reference to the finishing of lace curtains and blue-printed fabrics, samples of which are given. The amount of Aktivin required is 1% of the weight of the starch unless the starch is boiled under pressure, when a less quantity is required. The advantages of Aktivin over enzyme preparations are indicated. —B.C.I.R.A.

Raised Cotton Fabrics and Dress Fabrics: Finishing. E. Herzinger. *Leipzig. Monats., Text.-Ind.*, 1926, **41**, 113-114, 151-152.

The finishing of a number of coloured cotton materials with a woollen or felt-like appearance is described. Directions are given for making up the adhesive, the softening agent and the sizing oil. The fabrics dealt with are (*a*) fabrics raised or felted on both sides, such as coatings, velours, cheviots, &c.; (*b*) fabrics raised on one side such as flannelettes, &c.; (*c*) fabrics which are not raised or felted, but which are cheap and take a hard and cheap size. These include trouserings, clothing materials, zephyrs, and bed-ticking, &c. —B.C.I.R.A.

Artificial Silk: Strengthening. W. Bruckhaus. *Kunstseide*, 1926, **8**, 115-116.

Artificial silk is stronger in the wet state if it is treated, either in hank form or after

it has been converted into cloth, with a solution containing alum, lactic acid, and formaldehyde. The impregnated material is centrifuged till it contains about 100% of water, dried at a temperature not above 60° C., and soaped in a bath containing Marseilles soap, rinsed, treated with lactic or acetic acid and dried at a low temperature. The treated material is more resistant to water and alkalis and shows increased absorptive capacity for dyes. An alternative procedure is described, for which it is claimed that the breaking load of dry nitro-silk is increased in the ratio 100 : 140 and of the wet material by 100 : 350, and for viscose and cuprammonium silks by 100 : 133 and 100 : 355 for the dry and wet materials respectively. Treated thread is softer and more pliable than untreated thread and is therefore more easily worked up and gives rise to fewer faults. —B.C.I.R.A.

(L)—Waterproofing

Waterproofing [Fabrics] by Impregnation. I. Ginsberg. *Text. Col.*, 1926, **48**, 379-382.

Details are given of a number of methods for waterproofing cotton, hemp, and linen fabrics by means of aluminium acetate or formate and a soap, cuprammonium solutions, and a linseed oil varnish, machinery for carrying out the operations in a continuous manner being described. —A. J. H.

Cotton Fabric: Waterproofing. W. Bruckhaus. *Kunstseide*, 1926, **8**, 66.

Directions are given for coating or impregnating the surface of cotton fabrics with cuprammonium solution, with nitrocellulose varnishes, and with an "amyloid" coating formed by submitting the material to the action of strong sulphuric acid for a very short time and calendering. —B.C.I.R.A.

Patents

Cloth Measuring and Folding Machines. G. und E. Maag Co. Swiss P. 73,785 (from *Melliand's Textilber.*, 1926, **7**, 221).

All classes of fabrics including the most delicate can be folded on this machine. In the space of half a minute the machine can be adjusted to any desired measure and the adjustment can be made at a single point by means of a lever. The machine takes fabrics of 120 to 220 cms. width. —B.C.I.R.A.

Fast-coupled Dyeings on Wool. Badische Anilin & Soda Fabr., Asseen. of H. Krzikalla, H. Kammerer, and J. Nüsslein. U.S.P. 1,579,121 (from *J. Soc. Chem. and Ind.*, 1926, **45**, B536).

Wool and other animal fibre is impregnated with a sulphonated azo dye component containing an amino or hydroxy-group, or both, so that it can be coupled on the fibre with a diazo compound. The number of sulphonic groups must be reduced to a minimum to obtain a fast colour. Chromed and unchromed dyes which will couple may also be used to impregnate wool. For example, wool is boiled for one hour in a bath containing 1-5-di (6-sulpho-2-hydroxy-3-naphthoyl-amino) naphthaline, and is then treated with diazotised *m*-xylidine when a bluish-red shade fast to washing, milling, and light is developed. —B.R.A.W. & W.I.

Textile Fabrics: Finishing. J. Huebner, Cheadle Hulme, Cheshire. E.P. 250,283.

Textile materials composed wholly of animal fibres, or of animal fibres mixed with vegetable fibres are finished and ornamented by depositing cellulose upon such materials from a solution in ammoniacal cupric oxide and treating the material to remove the copper and to fix the cellulose on or in the fibres of the material. The process is applicable to woven, knitted, or felted fabrics and to yarns, warps, &c., which may have been scoured, bleached, dyed, mordanted, &c. Dyestuffs, mordants, pigments, &c., may be added to the cellulose solution which may be applied by printing, stencilling, padding, &c., to one or both sides of the fabric or the solution may be forced through fabrics to produce the same pattern on the back and front. The cellulose is precipitated on fabrics and the copper removed by passing the treated material through a bath of hydrochloric acid, or the material may be treated with caustic soda solution of 3-5° Tw. and then be washed, scoured, and again washed. The treated fabric may be dyed, mordanted, printed, &c., and the untreated parts may be raised. The behaviour of the cellulose treated parts towards certain dyes, mordants, &c., is modified. —B.C.I.R.A.

Artificial Silk Scouring and Dyeing Machine. Viscose Co., U.S.A., Marcus Hook, Pa., U.S.A. E.P. 250,303.

A modified form of a machine previously described. Vanes are used for distributing the liquid from the supply nozzle, the vanes being carried by the driving head or by the perforated cylinder. The construction of the carrier is simplified. —B.C.I.R.A.

Hank Mercerising Machine. P. Caldwell and British Cotton and Wool Dyers' Association, Ltd., Manchester. E.P. 250,392.

Apparatus for mercerising, &c., yarn samples in hank form comprises plates secured together by rods in tubes, the lower plate having a bracket for receiving a roller, and a second roller being carried by hooked and screwed stems adjustable in the upper plate for tensioning the hank. The stems

are connected by a handle piece carrying a graduated rod passing through the upper plate and the upper roller is rotated by a handle. —B.C.I.R.A.

Pleating Machine Belt. G. and R. Ezbelent, Rue de Belleville, Paris. E.P. 250,467.

To prevent the shrinking of the belt or other band of a machine for drying and fixing the folds of pleated goods, blocks of wood, rubber, &c., are attached to the inside or outside of the band at its edges, or the edges are beaded alone or around blocks, springs, &c., the blocks or beading engaging the ends of the rollers or fixed guides or stops. —B.C.I.R.A.

Yarn and Fabrics: Waterproofing. E. S. Ali-Cohen, The Hague, Holland. E.P. 250,623.

Fibrous material is impregnated with a mixture of rubber latex and soapy solution or emulsion, then subjected to a medium which coagulates rubber, washed, and dried. It may be pressed before the drying operation. The impregnation may take place at a temperature of 70°. Lampblack or other finely-divided carbon, filling materials such as clay or zinc oxide, and sulphur, if the product is to be vulcanised, may be added to the soapy solution. The soapy solution may consist of a dilute ammoniacal solution of a fatty acid or of a mixture of fatty acid with a mineral or vegetable oil or fat or saponin. —B.C.I.R.A.

Celluloid and Cellulose Acetate: Decorating. British Celanese, Ltd., London, and W. A. Dickie, and J. H. Rooney, Spondon, Derbyshire. E.P.250,658.

A material presenting moiré effects by transmitted light is produced by impressing close line or grid patterns on both faces of sheet celluloid, cellulose acetate or the like, so that optical interference effects are produced by the lines on the two faces. The two sets of lines or grids are generally slightly out of register. To produce the lines, the material may be pressed between heated plates or rollers bearing the desired pattern. Suitable printing surfaces comprise closely arranged parallel fine wires, fine wire gauze preferably of phosphor bronze, or metal plates or rollers engraved, etched, or scored with the line or grid pattern. —B.C.I.R.A.

Multiple Cylinder Drying Machines: Heating. G. Dod, Southport, Lancashire. E.P.250,746.

A method of heating multiple cylinder drying machines for fabrics consists in supplying steam to consecutive cylinders and for pairs or sets of cylinders from opposite ends of the machine and discharging the condensate from the opposite ends of the cylinders. The connection between each cylinder and its corresponding steam supply pipe consists of a pipe which is pivotally connected by a bolt to an enlarged boss on the steam pipe. —B.C.I.R.A.

Hank Dyeing Apparatus. Soc. Anon. de Teinture et Impression de St. Julien, Aube, France. E.P.250,899.

Apparatus for dyeing hanks in several different colours comprises a perforated table on which the hanks are laid side by side, and a travelling tank divided into a number of compartments from each of which there is a delivery pipe. Cocks on the delivery pipes may be opened and closed by means of a bar. A perforated pipe is provided for rinsing. The travelling tank, which may be removable, is mounted on a re-carriage, suspended from rails, and motor-driven. —B.C.I.R.A.

Rapid Bleaching Process. *Dyer and Calico Printer*, 1926, **55**, 232-233.

A full abstract of E.P.251,014. Cellulosic materials including yarns and fabrics are bleached without deterioration or formation of oxycellulose by saturation with a solution of hypochlorite containing 20-30 g. of available chlorine per litre, excess of liquor being removed by squeezing or centrifuging, and bleaching completed by heating the resulting textile material to 30-40° C. and subsequently washing it. —A.J.H.

Sulphite Cellulose Liquor: Application. A.-G. für Anilin-Fabrikation, Treptow, Berlin. E.P.251,019.

A non-deliquescent body soluble in water is prepared from sulphite cellulose liquor by freeing the liquor from deliquescent substances, or by separating the lignin sulphonates without the deliquescent substances, and drying, by means of heat with or without a vacuum, the lignin sulphonates or the liquor which contains them and has been freed from deliquescent substances. The lignin sulphonates may be precipitated by an organic precipitant, such as alcohol, or the deliquescent substances may be decomposed by oxidising agents, acids, or alkalis or converted into non-deliquescent substances by condensation with an aldehyde, a carboxylic acid or an oxyaryl compound, such as a phenol or salicylic acid, and the lignin sulphonates may then be salted out. The product is useful as an adhesive for mordanting, tanning, and protecting animal fibres from the injurious effects of alkaline liquid. —B.C.I.R.A.

Parchmentised Patterned Fabrics: Preparation. R. Clay, Ltd., H. M. Scott, and L. Thompson, Cheadle, Cheshire. E.P. 251,102.

Fabric containing cellulose is printed with a resist, then calendered, and finally treated with a parchmentising agent, to produce pattern effects or to leave the fabric more flexible in places where it has to

be folded, e.g., in the making of collars. The fabric may be conditioned or mercerised prior to calendering, and any usual preparatory, dyeing, or finishing process may be employed. —B.C.I.R.A.

Textile Materials and Paper: Waterproofing. C. Knopf, Hamburg, Germany. E.P. 251,126.

In the process of waterproofing textile material, paper, and the like by treatment with concentrated solutions of chlorides, such as those of zinc, aluminium, calcium, and strontium, the material is dried by heat before treatment with the solutions and subsequently heated to mature the amyloid formed by the solution treatment and cooled to prevent degeneration thereof. Apparatus for carrying out the complete process as a continuous operation comprises heated drums, a chloride bath, scrapers and pressure rollers for removing superfluous solution, a heated drum, a cooling drum, lixiviating baths for the recovery of salt solution, washing baths, a colouring bath, drying drums, and cooling drums. Squeezing rollers are provided in connection with each of the lixiviating and washing baths. Spraying tubes direct water against both sides of the material as it passes over rollers above the washing baths. The webs are guided over the drying rollers by endless felts. The apparatus may be applied in the treatment of material in sheet form, the sheets being guided through the apparatus by endless bands. —B.C.I.R.A.

Cellulose Esters: Dyeing. Badische Anilin and Soda Fabrik, Ludwigshafen-on-Rhine, Germany. E.P.251,155.

Cellulose esters are dyed with unsulphonated azo dyes containing at least one monoethanolamino group. The dyes may be employed in aqueous solution or suspension, with or without the addition of Turkey red oil or other dispersing agents. In examples, cellulose acetate silk is dyed in orange and scarlet shades with the dyestuffs obtained (1) by diazotising *p*-nitraniline and coupling with monoethanolaniline acetate or with monoethanol-*m*-toluidine, and (2) by diazotising 3-nitro-4-toluidine and coupling with monoethanolaniline. —B.C.I.R.A.

Artificial Silk: Fireproofing. J. R. Levaud, Schaerbeek, Brussels. E.P.251,227.

Nitrocellulose yarns are rendered incombustible by treatment with the following solutions in the order named—Formic or acetic acid, an alkali metal sulphide and magnesium sulphate, an alkali metal hydrosulphite, aluminium chloride, and finally ammonium sulphate, commercial ammonium carbonate, boric acid, and borax. —B.C.I.R.A.

Fabric Washing Machine. F. Casablancas Planell, Sabadell, Spain. E.P.251,249.

A method of dividing the upper roller in order to equalise the pressure in a fabric washing machine where a number of ropes are simultaneously passed between rollers is indicated and an arrangement of bearings permitting movement of the axes of the upper rollers in a vertical plane. —B.C.I.R.A.

Fabric Drying Machine. J. J. Lyth, Valleyfield, Quebec, Canada. E.P. 251,470.

In a drier, tubes are arranged to provide narrow parallel passages through which in normal working the material passes in straight lines and out of contact with the tubes which are in staggered relation to provide wider tortuous passages permitting zigzag passage of locally thickened portions of the material which would not pass straight through the narrow passages. Headers are provided with parallel butt-ended tubes each header forming one unit with steam inlet and outlet. Two such units are arranged so that the vertical tube rows interdigitate, leaving narrow passages between the tubes of the combined sections, these being in staggered relationship. Lugs are provided to support the free ends of the tubes, the lugs of adjacent headers forming cradles for the tubes. Rolls lead the cloth between the drying tubes and, owing to the staggered arrangement, the moisture is enabled to escape and wider tortuous passages exist so that a thick seam can pass through the drier with comparatively little resistance. In a modification the tubes may be U-shaped. —B.C.I.R.A.

Vat Dyes: Application. J. Morton, J. I. M. Jones, B. Wylam, Lancaster, J. E. G. Harris, and Morton Sundour Fabrics, Ltd., Carlisle. E.P.251,491.

Vat dyestuffs are converted into soluble derivatives by treating in the presence of a metal and a tertiary base with chlorsulphonic acid or its salts, fuming sulphuric acid, sulphuric anhydride, or salts of pyrosulphonic acid. Suitable bases, metals, acids, and vat dyes are specified. Textile materials may be dyed or printed with solutions of the products in water, alcohol, pyridine, &c., and the shade of the original dyestuff developed in a bath of an oxidising agent such as acid ferric chloride, alkaline hypochlorite, perborate, or permanganate. —B.C.I.R.A.

Tubular Fabric Stretching Frame. G. H. O'Brien, Manchester, for Terlinden and Co., Kusnacht, Switzerland. E.P. 251,548.

Tubular knitted fabric in a bunched-up form is placed on two arms, which are adjusted by a right and left-handed screw to a distance apart equal to the width to which the fabric is to be stretched, and then

drawn off the arms and over a steam chest by a roller. The front ends of the arms are cranked and tapered to a point or knife edge and the rear ends are fitted with runners bearing on the underside of a board extending across the machine.
—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Finishing—

250,582. J. Spiele. Cutting machine for split selvage fabrics.

251,357. Dunlop Rubber Co. and others. Rubber coating process for fabrics.

5—LAUNDERING AND DRY CLEANING

Soaps: Germicidal Properties. J. E. Walker. *Bot. Abs.*, 1926, **15**, 192 (from *J. Infect. Diseases*, 1924, **35**, 557-566, and 1925, **37**, 181-192).

A number of pure and commercial soaps, as well as soaps prepared in the laboratory from glycerides of common fatty acids, were studied in respect to their action on *Pneumococcus*, *Streptococcus*, *Staphylococcus*, and *Bacillus typhosus*. Of the pure soaps, laurates possessed the most general germicidal properties, caprylates were very weak, and caprates, myristates, palmitates, and stearates were intermediate. In general, salts of the unsaturated acids were most active. Blood serum reduced the intensity of germicidal action. Action was stronger at the higher temperatures. A 1 : 160 solution of any of the commercial or laboratory prepared soaps killed the diphtheria bacillus and *Streptococcus hemolyticus* in 2·5 minutes at 20° C. *Staphylococcus aureus* resisted the action of all the soaps at 20° for 15 minutes and all but brown bar soap at 35° for 15 minutes. *Staphylococcus albus* was not destroyed or completely removed after thoroughly washing the hands. Other organisms did not appear to resist such washing. *Streptococcus hemolyticus* was destroyed by washing for one minute with any of the soaps when a good lather was formed. Coconut oil soap was the only one destroying *Bacillus coli* with vigorous washing. The soaps had a strong germicidal action on the organisms contained in saliva and in general were strongly germicidal for the pneumococcus, streptococcus, and diphtheria bacillus. The presence of coconut oil in greater amounts would render the soaps more germicidal toward *B. typhosus* as well. The greater germicidal action of coconut oil soap is believed to be due to its higher content of saturated fatty acids.
—B.C.I.R.A.

Soap: Detergent Power. L. F. Hoyt. *J. Oil and Fat Ind.*, 1926, **3**, 48-51.

The tests formulated by the Detergent Sub-committee of the American Oil Chemists' Society are described. Two colour standards have been prepared and the exact way in which the preliminary soiling is to be effected, using standard materials, is described. —B.C.I.R.A.

Hydrocarbon Soaps: Properties. H. Sprenger. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 104-106.

The author discusses the properties required in good hydrocarbon soaps and the methods of obtaining them. The soaps must (1) act as "water soluble hydrocarbons," that is be capable of fine division in the wash water and have good wetting powers, (2) be good fat solvents and dirt emulsifying agents, (3) be non-injurious to the fibre, that is neutral, (4) be of high boiling point, (5) be non-active towards the fat constituents of the fibre, (6) leave the fabric odourless, and (7) be non-poisonous or injurious to the worker. —B.C.I.R.A.

Savonade as an Emulsifier. E. O. Rasser. *Chem. Abs.*, 1926, **20**, 304 (from *Kunststoffe*, 1925, **15**, 71-74).

Savonade is a compound of methylhexalin with an alkali soap of oleic acid. It is a viscous liquid soluble in water and is capable of forming transparent solutions with many water-insoluble liquid hydrocarbons. Its use in the preparation of benzine and petroleum soaps, boring oils, drawing oils, spinning oils, &c., disinfecting agents and insecticides is discussed. It is not injurious to the skin or textiles, has a marked cleansing action, is a good solvent for many organic compounds, mineral oils, fatty oils, &c., and is reasonably cheap. —L.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Laundering—

250,407. V. and S. W. Lister. Rotary receptacle washing machine.

250,441. H. Guttin. Process for making washing powders.

250,449. British - American Laundry Machinery Co. Pressing and ironing machine.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Rubber: Tensile Properties at High Temperatures. A. Van Rossem and H. Vander Meijden. *J. Soc. Chem. Ind.*, 1926, **45**, 67T-72T.

A method is described by which tensile tests were carried out at high temperatures with the ordinary Schopper dynamometer.

With increasing temperature the Schopper tensile curves shift towards the elongation axis. When heated for a longer period under mercury, vulcanised rubber becomes brittle. The time of heating necessary for the appearance of brittleness is dependent on the vulcanisation coefficient and the temperature of heating. The phenomenon of brittleness at high temperature disappears after cooling at the ordinary temperature. The tensile curve of the rubber after heating and subsequently cooling coincides with the original curve. It is shown that rubber during vulcanisation has tensile properties entirely different from those obtained after cooling at ordinary room temperature. —B.C.I.R.A.

Formaldehyde - Sodium Bisulphite Compounds: Estimation. W. Ledbury and R. Taylor. *J. Soc. Chem. Ind.*, 1926, **45**, 85T-89T.

The estimation of formaldehyde-sodium bisulphite by the "hypoiodite" method is described. Iodine in excess in presence of alkali oxidises the formaldehyde bisulphite according to the equation—

$$H.CHO.NaHSO_3+2I_2+5NaOH = H.CO_2Na+NaHSO_4+4NaI+3H_2O.$$

The reaction is quantitative under conditions of excess of sodium bisulphite or of formaldehyde. The determination of formaldehyde-sulphurous acid by the method is also described. —B.C.I.R.A.

Chlorination of Wool. S. R. and E. R. Trotman. *J. Soc. Chem. Ind.*, 1926, **45**, 111-115T.

It has been previously shown (*J. Soc. Chem. Ind.*, 1922, **41**, 219T) that wool is more quickly damaged by chlorine than by hypochlorous acid, and that damage caused during chlorination is due to free chlorine in the chlorinating liquors. Destruction of the epithelial scales of wool does not produce unshrinkability, although the felting power is diminished. Absolute unshrinkability cannot be produced by means of chlorine alone. The two phenomena, felting and shrinking, appear to be distinct, depending upon the different proteins present in the epithelium and cortex respectively (cf. *J. Soc. Chem Ind.*, **45**, 20T). The action of chlorine on wool takes place by both adsorption and chemical combination. When chlorine is used as hypochlorous acid, neither damage nor loss of weight is produced until over 4% of chlorine in the weight of wool has been absorbed (cf. E.P.239,360). In the case of chlorine, serious damage is apparent even when small percentages are employed, and the rate of adsorption is affected by the presence of acid. It is possible that hypochlorous acid may act by liberation of nascent oxygen. Other oxidising agents investigated reduced felting, proportionately to the number of epithelial scales destroyed, but no marked decrease in shrinkage was observed. The action of hypochlorous acid is fundamentally different from that of chlorine. —B.R.A.W. & W.I.

Cellulose: Action of Sulphuric Acid, and α-Cellulose: Isolation. K. Atsuki and T. Minaki. *J. Soc. Chem. Ind.*, 1926, B. 266-267 (from *Cellulose Ind., Tokyo*, 1926, **2**, 3-10).

Sulphuric acid at concentrations between H_2SO_4, H_2O and H_2SO_4, $3H_2O$ dissolves cellulose at the ordinary temperature without charring. Electrical conductivities of such hydrated forms indicate that the water is not entirely in combination. Dissolution of the cellulose is started by the combination of its OH groups with the sulphuric acid, followed by swelling and peptisation of the fibre. The rotation-time curve of the solution shows two points of inflection, and the viscosity decreases rapidly until the first point of inflection and then remains nearly constant as the cellulose changes from colloid to crystalloid. The cellulose recovered by dilution is in a highly hydrated condition, drying to a horny product, and the amount obtained after 30 minutes' contact is over 100%. The quantity recovered by dilution decreases and its copper value increases at quicker rates the higher the concentration and temperature of the acid. α-Cellulose may be extracted from wood by treatment with 64-66% acid at 10°-15°, or with 66-70% acid at 0°-10°, with but little loss. The wood, however, must be very finely powdered and passed through sieves of 64-120 meshes per sq. cm., and the precipitation of the cellulose by dilution must take place as soon as possible after solution. Japanese spruce yielded 45·2% of α-cellulose with copper value 1·30, free from furfuroids, but sometimes slightly contaminated with lignin. —B.C.I.R.A.

Malt: Diastatic Power. H. Lloyd Hind, H. Threadgold, C. W. B. Arnold. *J. Inst. Brewing*, 1926, **32**, 26-32.

It is suggested that the use of Sorenser's acetate buffer in quantity sufficient to give a *p*H of 4·6 be laid down as part of the standard method of determining diastatic power; 20 cc. of a buffer mixture consisting of 10 cc. *N*-acetic acid and 10 cc. *M*-sodium acetate per litre of 2% starch solution gives with any reasonably satisfactory preparation of soluble starch a solution of constant *p*H. The addition of this buffer appears to have no other effect on the starch conversion than is caused by stabilisation of hydrogen-ion concentration. —B.C.I.R.A.

Hydrosulphites and Sulphoxylates: Properties. C. S. Hollander. *Amer. Dyestuff Rep.* (*Proc. Amer. Assoc. Text. Chem. and Col.*,) 1923, **12**, 9-11.

A general lecture on some properties of commercial sodium hydrosulphite, sodium

sulphoxylate formaldehyde, zinc sulphoxylate formaldehyde, basic zinc sulphoxylate formaldehyde, and sodium sulphoxylate acetaldehyde. —B.C.I.R.A.

Water: Softening. H. L. Tiger. *Amer. Dyestuff Rep.* (*Proc. Amer. Ass. Text. Chem.*), 1924, **13**, 673-688.

A report of a paper dealing with the principles involved in the various methods of water purification, and the water requirements of the various textile processes to which cotton, wool, and silk are subjected. The Permutite softening process is described. —B.C.I.R.A.

Hydrogen Ion Concentration: Estimation. E. K. Strachan. *Amer. Dyestuff Rep.*, 1926, **15**, 291-296.

A useful and clear account is given of the meaning of hydrogen-ion concentration and *p*H and their determination. A few applications of *p*H measurements in textile finishing processes are suggested: for example, in controlling bleach liquors, and the growth of mildews. The author mentions that he hopes to investigate the iso-electric point of cotton and artificial silk. —B.C.I.R.A.

New Method for Staining Spores. D. Sabbadini. *Abs. Bact.*, 1925, **9**, 358 (from *Ann. d'ig.*, 1924, **34**, 177).

The staining fluid consists of six drops of a saturated watery solution of crystal violet and 9 to 10 or 12 drops of a 5 per cent. solution of carbolic acid. Some of this mixture is poured over smears made on slides or cover-slips and warmed for two to three minutes over a flame. Wash in running tap water, decolorise in either 1 per cent. nitric acid or 1 per cent. sulphuric acid (a few seconds), or 10 per cent. potassium sulphite (15-20 minutes), or a saturated alcoholic solution of picric acid (2-3 minutes), or absolute alcohol (10 minutes). Wash in tap water; counter stain with a diluted water solution of vesuvin; dry and mount in balsam. —L.I.R.A.

Mildewed Cotton Material; Methods of Examination of——. T. B. Bright. *Bot. Abs.*, 1926, **15**, 585 (*J. Roy. Micros. Soc.*, 1925, pp. 141-144).

Samples of cotton are stained in picro-nigrosin or cotton blue, mounted in thick Canada balsam and examined by means of a compound binocular microscope, using a $\frac{2}{3}$ inch objective, and a "Pointolite" lamp. In this way, the cotton fibres are rendered invisible and the fungus mycelia stand out clearly. —L.I.R.A.

Cotton Hair and Cellulose Acetate: Hygroscopicity. A. Caille. *Chem. Abs.*, 1925, **19**, 1498 (from *Bull. Soc. Ind. Rouen*, 1924, **52**, 422-426).

The hygroscopicities of certain American cottons were tested at relative humidities of 8-84%. For 12° and 50% relative humidity the moisture content is 7-7·1%, as compared with 8·5% admitted in commercial transactions. The hygroscopicity curve of cellulose acetate is practically a straight line, esterification of the OH groups of the cellulose appreciably diminishing the hygroscopicity of the cotton. At 63-68% relative humidity chlorinated cotton has a moisture content of 7·27-7·60%, as compared with 9·02-9·38% for bleached and mercerised cotton. —B.C.I.R.A.

Determination of Lignin. E. Hagglund. *Chem. Absts.*, 1925, **19**, 3015 (from *Papierfabr. Tech. Weiss. Teil*, 1925, **23**, 406).

The lignin determination of Schwalbe is considered inaccurate because a part of the lignin is dissolved by the acid mixture and rapid filtration is not possible. Following the Schwalbe procedure, but filtering on a quartz sand filter, gave a clear filtrate, which after 48 hours yielded a precipitate amounting to 3·1% of the wood substance and containing 16·3% CH_3O groups. This material possessed the properties of lignin. If the procedure is modified so that the mixture stands 24 hours before filtering, the filtrate does not yield a further precipitate. The per cent. lignin obtained in this way was 27·8, which compares favourably with 27·4 by the 41% HCL method. —L.I.R.A.

Dispersoidological Investigations. IV.—Dispergation and Aggregation in General and Particularly in their Application to Cellulose. P. P. Von Weimarn. *Chem. Abs.*, 1925, **19**, 3588 (*Reports Imp. Inst. Research, Osaka, Japan*, 1925, **5**, No. 18, pp. 7-185).

The author discusses in detail some theoretical problems of dispersion and aggregation in general and then describes work that has been carried out on the conversion of cellulose into all kinds of plastic or gelatinous masses or colloidal solutions with particular reference to the dispersion of cellulose by salt solutions (e.g., sodium chloride, barium chloride, lithium chloride, and calcium thiocyanate). The original paper should be consulted for the numerous data obtained. —L.I.R.A.

Buffer Mixtures that can be Prepared without the Use of Standardised Acid or Base; A New Set of——. I. M. Kolthoff. *Exp. Stat. Record*, 1925, **53**, 610 (from *J. Biol. Chem.*, 1924, **63**, 135-141).

The set of buffer mixtures described includes mixtures of 0·05 molecular succinic acid and 0·1 molar acid potassium phosphate (KH_2PO_4) with a *p*H range of from 3 to 5·8 and mixtures of 0·1 molecular primary potassium phosphate and 0·05 molar borax with a *p*H range of from 5·8

to 9·2. Methods of purifying the original substances and preparing the solutions are given, with data on their accuracy.

—L.I.R.A.

Increasing the Internal Volume of Silica Gels by Moist Heat Treatment. H. N. Holmes, R. W. Sullivan, and N. W. Metcalf. *J. Soc. Chem. Ind.*, 1926, **45**, B438 (from *Ind. and Eng. Chem.*, 1926, **18**, 386-388).

Silica gel, prepared by adding ferric chloride to a solution of sodium silicate, and boiling the gelatinous precipitate with hydrochloric acid, has a high absorptive capacity, absorbing 62% of benzine vapour against 32% for a standard silica gel. This is owing to the porous nature of the gel produced by the extraction of ferric hydroxide during the boiling with acid. The absorption can be enormously increased by slow drying of the gel; further, if the partially dried gel with a water content of about 60% is submitted to syneresis in a closed vessel for two to three weeks, before boiling with acid, a gel which absorbs up to 133% of benzine vapour can be obtained. —B.R.A.W. & W.I.

Foam Meter. H. E. Williams. *Ind. and Eng. Chem.*, 1926, **18**, 361-362.

Essentially, the apparatus consists of a bowl in which the liquid to be tested is beaten by a motor-controlled beater, and an outlet to a flask of standardised volume, this volume being known as the "foam meter volume." The liquid is beaten for a given length of time, the outlet is opened and sufficient foamy liquid run out to fill the flask. Any head is removed with a spatula and the flask and its contents are weighed. The foaming liquid weight is found by subtracting the weight of the dry flask from the gross weight. The foaming tendency of paints, varnishes, glues, creams, &c., can therefore be expressed numerically on the basis of the ratio of the weight of the material placed in the bowl to the weight of the foam meter volume of material after whipping. The apparatus has been applied in testing the foam-reducing powers of numerous anti-frothing oils. —B.C.I.R.A.

Pectin; The Determination of——: Titration Method. C. F. Ahmann and H. D. Hooker. *Ind. and Eng. Chem.*, 1926, **18**, 412-424.

The determination of pectin is carried out by saponification of a solution containing 1·25 to 5·0 gms. pectin per litre with decinormal sodium hydroxide (12 hours at 55° C.) and estimating the excess alkali by titration with hydrochloric acid. The method is described in detail and tables and curves showing the results obtained in theinvestigation on which the method is founded are given. —L.I.R.A.

Raw Cotton: Standardisation. O. F. Cook. *J. Heredity*, 1926, **17**, 3-9.

The present system of cotton classification is shown to be entirely unsatisfactory and a plea is made for the further development of one-variety communities, when uniform, standardised crops would be obtained. The cost of maintaining uniform seed stocks would not be greater than the cost of classifying the present miscellaneous product and the cotton would be much more valuable. Pictures are given of combed-out seeds of Meade, Columbia, and Lone Star cottons showing lack of uniformity in unselected stock. The Columbia strain frequently shows "butterfly" shapes, through the hairs at the base of the seed being short and those at the top long. —B.C.I.R.A.

The Effect of Humidity on the Thermal Conductivity of Wool and Cotton. H. Staff. *Phys. Rev.*, 1st Feb. 1925.

The Lee's disc for determination of conductivity is adapted. Layers of material are placed between a central electrically heated disc and two outer heavy copper discs which are water cooled. The thermal conductivity can thus be measured close to room temperature with any desired moisture content. Results show a fairly linear relation between conductivity and percentage regain and that conductivity increases more nearly as the square of the relative humidity. The values given for wool are from $1{\cdot}7$ to $2{\cdot}0 \times 10^{-6}$ and for cotton $3{\cdot}9$ to $4{\cdot}0 \times 10^{-6}$, for the increase in conductivity of dry material for an increase in moisture content of 1% of the dry weight. —B.R.A.W. & W.I.

Artificial Silk: Specifications. Committee D-13; American Society for Testing Materials. *Text. World*, 1926, **69**, 2325-2326.

A revised report on specifications and test methods for artificial silk. Some alterations have been made in the section dealing with the identification of artificial silks and a regain of 14½% is suggested for viscose, cuprammonium, and nitro silks as compared with 11½% in the earlier report; the 6·5% regain for cellulose acetate silk is retained. —B.C.I.R.A.

Leather Belting: Testing. L. W. Arny. *Text. World*, 1926, **69**, 2343, &c.

The quality of a leather varies with the part of the animal from which it has been obtained and with the treatment it has received in tanning and currying. Bending, strength, elongation and thickness tests for judging the quality of leather belting are described. —B.C.I.R.A.

Serigraph: Application. W. F. Edwards. *Text. World*, 1926, **69**, 2355-2359.

The author suggests that the serigraph test is the most suitable test for general adoption for all textile yarns. A brief outline of the test as applied to raw silk is given.

Comparative tests were made on the same cotton yarns by the single strand, lea, and serigraph methods. The results justify further investigation of this test as a standard test for cotton yarns.

—B.C.I.R.A.

Cotton Spinning Tests in the U.S.A. H. H. Willis. *Text. World*, 1926, **69**, 3021-3023.

A short account of the work of the U.S. Department of Agriculture in co-operation with the textile department of Clemson Agriculture College in carrying out tests of the spinning values of raw cottons. Pima cotton has been shown to be equal to equivalent grades of Sakel. American, Egyptian, Sakel, and Sea Island cottons can be used in place of linen for airplane fabrics. Compression in the bale to high densities does not injure cotton provided the bale is not compressed when wet. The spinning value of a cotton is unaffected by fumigation with hydrocyanic acid gas. Special strains of Acala cotton grown in California were found to possess high spinning value. Pure varieties are superior to mongrel cotton in respect to waste, strength, and evenness of yarn.

—B.C.I.R.A.

Dye Mixtures: Spectrophotometry. W. C. Holmes. *Amer. Dyestuff Rep.*, 1926, **15**, 189-191 and 247-248.

(1) A short article on the spectrophotometric analysis of mixtures of dyes. (2) A discussion of the choice of solvent in spectrophotometric dye analysis.

—B.C.I.R.A.

Rapid Qualitative and Quantitative Analysis of Commercial Hydrogen Peroxide. A. Quartaroli. *Chem Abs.*, 1925, **19**, 2612 (from *Ann. Chim. Applicata*, 1925, **15**, 32-35).

Dilute the hydrogen peroxide with water to four times its volume, add to 20 c.c. of this, 2 c.c. of 1·5% copper sulphate and 2 c.c. of 20% sodium hydroxide and measure the volume of oxygen evolved. This test can be done accurately enough for commercial work with a test tube connected with a graduated U tube or ureometer. Evolution is rapid and complete without heating and the test is simpler and more reliable than titration with potassium permanganate.

—L.I.R.A.

Cottonseed Lint: Estimation. T. L. Rettger. *J. Oil and Fat Ind.*, 1926, **3**, 135-136.

Eight to ten drops of 40% hydrochloric acid is placed in a small beaker. A weighed quantity of cottonseed is placed loosely in the beaker and is protected from direct contact with the acid by a screen of monel metal. The beaker is covered with a watch glass and heated for 10 minutes in an oven at 110° or on a hot plate with a surface temperature of 140°. The cover is removed and the sample heated for a further 10 minutes, after which it is spread on a clean surface to cool, weighed, rubbed in a cloth to remove the hydrocellulose, cleaned on a sieve and reweighed. The loss in weight is lint. A blank experiment must be made on a sample of bald seed to enable a correction to be obtained for small particles of hull which are removed in rubbing.

—B.C.I.R.A.

Cottonseed: Analysis. Seed Committee of the American Oil Chemists' Society. *J. Oil and Fat Ind.*, 1926, **3**, 34-36.

Directions are given for the preparation of the sample and determination of impurities and for the estimation of moisture, oil, and ammonia.

—B.C.I.R.A.

Value of Fibre Testing Machines for Measuring the Strength and Elasticity of Wool. J. A. Hill. *Wyoming Agric. Exp. Sta.*, Bulletin No. 92.

A summarised note of the work on strength and elasticity of wool performed by the author and others in the University of Wyoming. A special testing machine designed by the Philadelphia Textile School was used for the tests. The fibre is clamped between two jaws, one of which is fixed and the other attached to a balance beam. The load is placed on the fibre by alteration of the equilibrium of the beam by means of a movable bar which moves laterally, so as to disturb the position of the centre of gravity of the beam. The movement of the bar is read off on a calibrated wheel attached to the propelling mechanism of the bar. The wheel is graduated in decigrams. The machine, as described, seems to give only a rough test and is a very crude edition of Barratt's electromagnetic balance without the electrical load appliance. A discussion is given illustrating the necessity of large numbers of tests to be made before any conclusion can be arrived at, and tables are appended showing mean fibre strengths for a large variety of wool fleeces, and the limits of variation between the strengths, &c., of the samples tested. The statement is made that "all testing was done under ordinary room conditions." (No record is given of what these were and no values of humidity or temperature are recorded. Unless standard conditions are imposed such results as are obtained have no certainty of definition.—Abstractor.)

—B.R.A.W. & W.I.

Oil Content of Flax Seed; A Simple Test for Determining the——. D. A. Coleman and H. C. Fellows. *Exp. Sta. Rec.*, 1925, **53**, 611 (from *U.S. Dept. Agr. Bur. Agr. Econ. Grain Invest.*, Publication 33, 19 pages).

This publication presents data on the domestic production and importation of flax seed in the United States from 1911 to 1924 inclusive, outlines present methods of inspecting and grading flax seed, with data showing that these methods are of doubtful value in indicating the oil content of the samples; and describes the developments

of a rapid oil test which is said to be as accurate as the ether extraction method. The new method is an adaptation of the Wessen optical method of determining the oil content of cottonseed meal, which is based on the differences in refractive indices of the oil and of the solvent used in the extraction. As in the original method, Halowax oil is used as the solvent, the difference in the refractive indices of the two oils being 0·15476. With the Valentine refractometer and a temperature of 25° C., the dilution of Halowax oil with pure linseed oil lowers the refractive index of the former by 0·001906 for every per cent. of linseed oil in the mixture. The details of the method are given in full, with a table for converting the refractometer readings into percentages of linseed oil and data showing the accuracy of the new method as compared with the official ether extraction method. Of the 120 samples tested, 48·7% varied less than 0·1 of a per cent. from the official method, 32·8% more than 0·1 and less than 0·19%, and only 4·2% more than 0·3%, the greatest variation being only 0·33%. It is estimated that after the analyst has become thoroughly familiar with the technique from 10 to 12 tests can be made easily in an hour. —L.I.R.A.

Chlorides: Decomposition by Oxalic Acid. W. Moldenhauer. *Z. angew. Chem.*, 1926, **39**, 557-559.

It is shown that hydrochloric acid is expelled entirely when a chloride is evaporated to dryness with 6-8 times its weight of oxalic acid. Thus sodium chloride may be converted into carbonate and actually used as a reference substance for standardising acids. Magnesium and calcium chlorides yield the oxide (or carbonate) and can be estimated by dissolving this residue in excess of standard acid and titrating back. —B.C.I.R.A.

Carbon Disulphide and Hydrogen Sulphide: Estimation. K. Hegel. *Z. angew. Chem.*, 1926, **39**, 431-432.

The methods were devised for determining the amounts of the gases liberated from viscose by acid decomposition. Carbon disulphide is weighed as the red crystalline additive compound which it forms with triethylphosphine in ether solution. The solution, which should be freshly prepared, is cooled to —10°. Hydrogen sulphide is estimated by passing the gases into a standard iodine solution and determining the excess of iodine with thiosulphate. —B.C.I.R.A.

Copper, Detection of; Two New very Sensitive Reactions for the——. G. Spacu. *Chem. Abs.*, 1925, **19**, 3444 (from *Z. anal. Chem.*, 1925, **67**, 31-32).

If a very dilute solution of copper is treated with a few drops of potassium sulphocyanide and not more than two drops of a 2% freshly precipitated solution of toluidine in alcohol, a very characteristic blue flocculent precipitate results. This amine is insoluble in water but dissolves easily in alcohol. If a dilute copper solution is treated with 2 c.c. of potassium iodide and then with three drops of freshly prepared 1% benzidine solution in alcohol, a flocculent dark blue precipitate results. In the absence of ferric iron the presence of 0·02 mg. of copper can be detected in 10 c.c. of solution. —L.I.R.A.

Glycerol: Estimation. R. Strebinger and J. Streit. *Chem. Abs.*, 1924, **18**, 2857 (from *Z. anal. Chem.*, 1924, **64**, 136-143).

Details are given of a method for estimating glycerol based on its oxidation by potassium iodate and concentrated sulphuric acid. The reaction is formulated thus—

$$5C_3H_8O_3 + 14KIO_3 + 14H_2SO_4 = 14KHSO_4 + 15CO_2 + 27H_2O + 7I_2.$$

—B.C.I.R.A.

Textile Fibres: Breaking Load and Strength when Wet. J. Obermiller and M. Goertz. *Melliand's Textiber.*, 1926, **7**, 163-168, and 245-246.

Krais' balance was used for the investigation. In this apparatus the fibre is held between two clamps, the upper of which is attached to a balance beam and the lower to a small rigid column immediately below it. The second balance beam carries a pan into which water flows from a burette until the fibre breaks. Krais' method of mounting the fibres in paper frames was thought to have a definite effect on the mechanical-physical properties of the fibres and was replaced by a method in which the fibre is held in strips of cork which are split for about two-thirds of their length. The upper end of the fibre is placed between the two parts of a strip, the parts are held together and the whole is secured in a clamp. The lower end of the fibre is similarly secured. To determine the wet strength of fibres, about 4-5 mms. of half-pressure tubing is slit and placed round the fibre, forming a small cup which has the cork strip for its base and which can be made water-tight with a little vaseline. This is said to be the only method of determining the breaking load of wet fibres which gives reliable results. In the wet experiments the point of rupture of cotton, the strength of which increases in the wet state, is generally above the level of the water, and of other fibres, the strength of which decreases in the wet state, is below the water level. The results of individual experiments should be arranged in order of magnitude, as this gives a rapid idea as to whether an average sample of the fibre has been taken. If the sampling was good, the results will increase fairly regularly, but with bad sampling there will be gaps in the series. The minimum number of breaks required to define a breaking load is 50, and this is not always sufficient to give a true estimation. A comparison of the results of 50 with 100 experiments shows that 50

experiments is not sufficient to give a true conception of the "relative wet strength" of fibres (i.e., the percentage gain or loss of strength as compared with the breaking load of the dry fibre), but that 100 experiments give much more uniform results. Experiments on crude and benzene-extracted fibres show that extraction has no effect on relative wet strength. Atmospheric humidity influences the relative wet strength of fibres; for silk and artificial silks the relative wet strength increases with increasing relative humidity, but for cotton and wool the effect of humidity is less clearly defined. Adler and Holken silks, both of which are cuprammonium silks, have almost the same relative wet strength. The thickness of fibres has very little effect on their relative wet strengths. The following approximate figures are given for the relative wet strengths of fibres at moderate humidities—

Cotton	110-120%
Wool	80- 90%
Silk	75- 85%
Cuprammonium silk ...	50- 60%
Viscose silk	45- 55%
Nitro silk	30 -40%
Acetate silk	65- 70%

These figures are lower than those obtained by Krais; the discrepancy is due to the small number of experiments made by Krais, although he determined the cross-sectional area of the fibres used, to his disregard of humidity conditions, and chiefly to the fact that the fibres were wet out and broken in the air so that they were more or less dried before breaking. Willkomm's claim that the breaking load of cotton hairs increases up to 80% relative humidity and then falls, is not confirmed. Series of experiments were made in which the breaking loads of fibres which had been exposed to air of definite humidity for definite periods of time and at definite temperatures, were compared with the breaking loads of the untreated fibres. Cotton hairs showed a definite fall in breaking load and in relative wet strength due to previous exposure. The exposed cotton became yellow and showed a high oxycellulose content. Artificial silk showed no clear difference between the breaking loads of the exposed and unexposed samples. The following figures are given—

	Relative Humidity %	Relative Wet Strength	Time of Exposure: Days at Ord. Temp.	Time of Exposure: Hours at 75-100°	Relative Humidity %	Relative Wet Strength
Texas cotton ...	56/21°	114 %	81	87	58/19°	108·1%
Indian cotton	56/22°	112·9%	81	87	64/19°	101·7%
Adler silk ...	68/20°	59·7%	103	119	60/22°	52·0%
Vistra ...	60/22°	53·4%	103	119	63/21°	51·7%

By exposure to air the hygroscopicity of fibres gradually falls, especially if the fibres are exposed at high temperatures, and a similar decrease in breaking load is observed. —B.C.I.R.A.

Sulphonated Oils: Acid Stability. H. Pomeranz. *Melliand's Textilber.*, 1926, **7**, 447.

The meaning of the term acid stability as applied to sulphonated oils is discussed, and it is shown that titration of the oil with dilute acid until a cloudiness appears gives no indication as to whether the oil may be used in dyebaths or the amount required. —B.C.I.R.A.

Faulty Artificial Silk Cloth: Causes. F. Müller. *Melliand's Textilber.*, 1926, **7**, 329-332.

Tensioned weft threads may be due to the use of unsuitably shaped weft spools. The spools should have tapering ends, thus permitting the weft to be drawn off without bending it over a sharp edge. This fault is not to be confused with shiny places due to stretching the thread during reeling and winding. Streaky dyeing in woven artificial silk fabric is due to faults in the raw material which only become apparent after dyeing. The only means of control is the use of revolving change box looms which allow the weft to be changed at every two picks. —B.C.I.R.A.

Autographic Load-extension Recording Machines. F. Pichler. *Melliand's Textilber.*, 1926, **7**, 246-248 & 366-368.

It is pointed out that breaking load tests and regularity determinations are useless if the number of experiments made, the length of yarn between the jaws, the humidity, the rate of loading and extension, the work of rupture and the type of testing machine are not recorded. Extension and work of rupture are particularly important. The usual method of taking the mean of ten determinations of breaking load and extension and calculating irregularity from them is shown to give not only inaccurate results but to lead to wrong conclusions. The quality of a yarn depends chiefly on the work required to break it. This work is represented graphically by the ratio of the area enclosed by the load-extension curve and the axes to the area of the rectangle enclosing the curve. Conditions of test for obtaining accurate results are indicated and two testing machines are described in which the load-extension curves are recorded automatically. The Schopper machine with the Schopper recorder may be equipped with the Alt mechanism, which either maintains the rate of load constant or records the rate of load as it varies. The Zedlitz-Krynes recorder is used with the second machine. —B.C.I.R.A.

Yarn: Breaking Load Irregularity. A. Lange. *Melliand's Textilber.*, 1926, **7**, 168.

In calculating the average irregularity, or percentage deviation from the mean

breaking load, of a yarn, the results are widely different according as the sub-mean is determined by calculating the sub-mean of every ten experiments and averaging the results, or the sub-mean of the whole series of results is determined directly. In an instance quoted in which 100 experiments were made, the average irregularity calculated by the first method was 6·65% and by the second method was 9·64%. The author believes the second method in which the sub-mean of the series as a whole is determined to be the more correct. A third method is to determine the irregularity given by every ten experiments and average the figures obtained. For the experiments referred to above, the result by this method is 6·78%. —B.C.I.R.A.

Polysaccharides: X-ray Structure. E. Ott. *Physikal. Z.*, 1926, **27**, 174-177.

Röntgen ring diagrams were obtained for carbohydrates of high molecular weight, and the values of Q recorded for strong and weak intensities for a number of carbohydrates, including starch and cellulose. From Bragg's equation, $d=\lambda/2$ Sin Q, the upper volume limit of the element space is calculated, and this value divided by the element volume of a $C_6H_{10}O_5$ group gives the degree of polymerisation of the carbohydrate. The following formulæ were established—Diamylose $(C_6H_{10}O_5)_{22}$ as compared with a value $(C_6H_{10}O_5)_2$ found by chemical means; tetra-amylose $(C_6H_{10}O_5)_{12}$ as compared with $(C_6H_{10}O_5)_4$; octa-amylose $(C_6H_{10}O_5)_{63}$ as compared with $(C_6H_{10}O_5)_8$. Triamylose $(C_6H_{10}O_5)_6$, hexa-amylose $(C_6H_{10}O_5)_6$ and inulin $(C_6H_{10}O_5)_6$ are in agreement with chemical measurements. The Röntgen diagram shows the identity of tri- and hexa-amylose and the non-identity of inulin with hexa-amylose. Cellulose $(C_6H_{10}O_5)_3$ is in agreement with modern views of cellulose as a tri-polymeride. Lichenin $(C_6H_{10}O_5)_7$ and starch $(C_6H_{10}O_5)_2$ are also in agreement with modern theory. —B.C.I.R.A.

Absorbent Cotton: Grading. A. Lohmann. *Chem. Abs.*, 1925, **19**, 376 (from *Pharm. Ztg.*, 1924, **69**, 1076-1077).

A plea for a more rational system of grading absorbent cotton. Four grades are suggested: For use in eye and teeth operation, consisting entirely of linter-free fibre; for wounds, containing up to one-third best linters; for gynecological application, containing about one-half linters; for the veterinary surgeon, containing three-quarters or more linters. —B.C.I.R.A.

Cotton: Grading. T. Bühler. *Leipzig. Woch. Text.-Ind.*, 1925, **40**, 1193-1194.

The author discusses the present methods of valuing raw cottons as employed by buyers and points out their inaccuracies. He cites particularly cases in which a hand-stapled sample gave as many as three staple diagrams. He suggests the establishment of a European (or German) cotton testing house and urges the necessity for collecting and publishing comprehensive cotton statistics, independently of America. —B.C.I.R.A.

Oxycellulose: Detection. E. Ristenpart. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 144.

The error in comparing with standard whiteness the whiteness of material tested for oxycellulose with methylene blue in a half shadow photometer by first destroying the blue of the sample by a filter can be overcome if the two areas have exactly the same colour tone. The Ostwald Filter 2 is a convenient stop filter for the purpose. With this, in a Janke and Kunkel photometer the permanent white and the blue-dyed sample appear in the same region of the red and equal brightness is attained with sharp definition. —B.C.I.R.A.

Müller Staple Tester: Calibration. E. Müller. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 124-126.

A method of calibrating the Müller staple tester is given; for use with wool tops. —B.C.I.R.A.

Tetrapol: Composition. —. Welwart. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 57.

The author refers to a number of recent analyses of Tetrapol samples which have contained carbon tetrachloride and suggests that two grades have been sold by the Stockhausen Co., one made with carbon tetrachloride and the other with (only less noxious) perchlorethylene. —B.C.I.R.A.

Müller Rubbing Tester: Application. H. Vollprecht. *Leipzig. Monats. Text-Ind.*, 1926, **41**, 38-39.

Applications are described of the Müller rubbing tester which comprises a means of stretching the fabric horizontally and a weighted metal concave surface which traverses the fabric backwards and forwards lengthwise. The metal surface is covered with suitable material; for instance, if stocking fabric is to be tested the rubbing part is covered with a piece of the material commonly used for lining shoes. For distinguishing the resistance to rubbing of two nearly similar fabrics a method is described involving the testing of the material in the wet state. A method of testing heald cords by subjecting them to friction from an abrasive surface is also described. The apparatus may be used for testing the fastness of dyes to rubbing. —B.C.I.R.A.

Textile Fibres: Microscopic and Micro-Chemical Examination. F. Pichler. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 20-22, 60-61, 103-104, 143-144.

The article is divided into five sections comprising (1) micro-chemistry, including the preparation of the fibres for microscopic examination, the application and preparation of micro-chemical reagents and the preparation of fibre sections, (2) the use of the microscope in fibre examination, (3) the microscopic structure of the common textile fibres, including cotton and artificial silk, (4) the differentiation of cotton from mercerised cotton, animal from vegetable fibres, cotton from linen, &c., (5) the methods of distinguishing between artificial silks. The article describes a permanganate method of testing bleached cotton for oxycellulose. A test for cuprammonium artificial silk is described which depends on the fact that the trace of copper in the material catalyses the reducing action of thiosulphate on the red ferric thiocyanate. —B.C.I.R.A.

Clay Suspensions: Viscosity. K. Nishikawa. *Kolloid Z.*, 1926, **38**, 328-333.

Viscosity measurements on a number of clays and kaolins were made with an Ostwald apparatus in which the pressure and therefore the rate of flow were variable. Relative times of flow of suspensions of different concentrations and of water are tabulated. The results show that for high rates of flow the Hagen-Poiseuille law is nearly obeyed and holds the more accurately the greater the rate of flow, that is, the thinner the suspension. In this region there exist only small differences between the viscosities of different clays. The differences are greater at slow rates of flow, that is in the region of "structure" viscosity. This latter viscosity measurement can be applied to the differentiation of clays in analysis. The author derives a formula connecting pressure and time of flow which holds for solutions with structure viscosity and also in the region of short time of flow. —B.C.I.R.A.

Gelatin Sols: Viscosity. H. Freundlich and H. Neukircher. *Kolloid Z.*, 1926, **38**, 180-181.

The influence of varying hydrogen-ion concentration on the viscosity and elasticity of gelatin sols was investigated with the Hess apparatus. From the resulting curves which show deviation from Poiseuille's law the viscosity and elasticity of the solutions were derived. Both are minimal in the region of the iso-electric point and maximal towards the acid side. —B.C.I.R.A.

Oiliness Testing. See Section 7D.

Lubricants Testing. See Section 7D.

Absorption of Gases by Liquid Drops. See Section 7H.

7—BUILDING AND POWER

(B)—Fire Prevention

Paint Soaked Cotton Waste: Spontaneous Combustion. F. Taradoire. *Chem. Abs.*, 1925, **19**, 1500-1501 (from *Rev. prod. chim.*, 1925, **28**, 114-115).

The course of spontaneous combustion of cotton waste soaked with paint materials, namely, a mixture of linseed oil, turpentine and a liquid drier composed of manganese resinate and rosin dissolved in crude xylene is described; the turpentine and xylene do not appear to take part, but the presence of drier (at least 1%) is indispensable. The time for combustion to set in (1-6 hours) is much longer if linseed is replaced by colza oil. The use of paint retards combustion, probably because the pigment interferes with air circulation. There is an optimism paint-to-cotton ratio at which combustion sets in most rapidly, and a maximum ratio beyond which there is increase in temperature without combustion. Spontaneous combustion is explained as follows—the paint or vehicle covers the numerous fibres and evaporation of the turpentine and xylene deposits a fine film with large surface, facilitating the rapid exothermic oxidation of the drier and oil with rise in temperature to 200-220°; beyond this cotton undergoes decomposition which raises the temperature to 300°, at which it ignites. —B.C.I.R.A.

(C)—Power

Mill Shafting: Aligning. C. L. Hubbard. *Text. World*, 1926, **69**, 2339-2343.

Two general methods of testing the alignment of new and old shafting are described. It is important that old shafting should be continually trued, as inaccurate alignment leads to friction losses. —B.C.I.R.A.

Cotton Mill: Mechanical Supervision. S. S. Paine. *Mech. Eng.*, 1926, **48**, 432-434.

The paper is a general discussion of the need for making fundamental measurements in a cotton mill and for laying down standards of machine performance. Examples are given of haphazard control of twist gears, roller settings and so forth observed in various mills, and the author argues in favour of exercising the careful supervision which is the rule in mechanical industries. —B.C.I.R.A.

Artificial Silk Centrifugal Spinning Apparatus: Dynamics. R. Weisse. *Melliand's Textilber.*, 1926, **7**, 323-326.

The dynamic principles underlying the design of centrifugal spinning apparatus to give vibrationless running of the spindle are discussed. Some experiments are described and resonance phenomena are shown to be the chief dynamic factors in the movement of centrifugal spindles. —B.C.I.R.A.

Textile Machinery: Driving. J. Centmaier. *Melliand's Textilber.*, 1926, **7**, 109-110, 193-196, and 273-275.

The general principles of the individual electric drive are dealt with and it is compared favourably with the group method of driving textile machines. The selection and erection of motors for individual driving is discussed. —B.C.I.R.A.

(D)—LUBRICATION

Lubrication. H. A. S. Howarth. *Ind. and Eng. Chem.*, 1926, **18**, 453-460.

Full and partial journal bearings are studied graphically to obtain a set of fundamental laws governing the actual lubrication of all plain journal bearings. —B.C.I.R.A.

Lubrication. D. P. Barnard. *Ind. and Eng. Chem.*, 1926, **18**, 460-462.

The paper describes a simple method of developing the approximate laws controlling oil flow through bearings—due both to pressure developed in the film and to oil-feed pressure—and presents some experimental data in substantiation of this method. —B.C.I.R.A.

Lubrication. L. W. Parsons and G. R. Taylor. *Ind. and Eng. Chem.*, 1926, **18**, 493-496.

The authors point out that the main variables influencing the lubrication of a given journal bearing are (1) the ratio viscosity × speed of rotation/pressure on the bearing, and (2) the property of the oil known as oiliness, film-forming tendency, &c. Under the diverse conditions of modern machinery one or other factor attains the greater importance, and lubricating oils should be selected in the light of the particular performance required of them. Notes on lubricant requirements for turbines, automobiles, &c., are given. —B.C.I.R.A.

Graphite Lubricants: Properties. F. L. Koethen. *Ind. and Eng. Chem.*, 1926, **18**, 497-499.

Employing oil alone and oil + graphite, the author performed tests on a Riehle friction testing machine to determine the pressure required to rupture the fluid film in a 3-inch bearing rotating at constant speed. He also measured coefficients of friction on a sliding weight apparatus described. The results indicate that graphite is effective in prolonging the period of unbroken film lubrication, and in the ruptured film stage it reduces friction and minimises metallic contact. —B.C.I.R.A

Lubricating Oils: Properties. M. V. Dover. *Ind. and Eng. Chem.*, 1926, **18**, 499-501.

The physical constants of three mineral oils and olive oil are discussed in relation to the value of the oils as lubricants. The physical properties determined include, flash point, specific gravity, surface tension, interfacial tension (oil and water) viscosity, acid number, iodine number, and static coefficient of friction. The efficiencies of the oils as lubricants were calculated from the coefficient of friction by Deeley's formula. —B.C.I.R.A.

"Oiliness" Testing. A. H. Gill and Helen Gill. *Ind. and Eng. Chem.*, 1926, **18**, 527.

The authors describe a possible test for oiliness which consists in measuring the deflection in a MacMichael viscometer of oil alone and oil + diatomaceous earth at speeds of rotation varying from 5-80 per minute. The observations are plotted with degrees MacMichael as ordinates and rotations per minute as abscissæ. The "spread" or difference between the two straight lines obtained is read off in degrees MacMichael and changed to centipoises by similar graphs obtained with glycerol solutions of known viscosities. Results are given for some typical lubricants. While the method is tentative, the experiments confirm Perrott's work on carbon blacks. —B.C.I.R.A.

Lubricants: Testing. W. F. Parrish. *Ind. Eng. Chem.*, 1926, **18**, 525-526.

Lubrication tests were carried out in Germany on a cotton ring spinning frame and cotton twisting frame with two oils, one an American oil and the other a blended oil made up to match the first. The results show the difference in performance of two oils of the same initial viscosity, and analyses after running indicate a much greater change in the physical properties, including viscosity of the blended oil than in the American oil. The value of a lubricant for use under modern conditions in continuous lubricating systems is thus not entirely indicated by the viscosity of the oil when new. —B.C.I.R.A.

Oiliness Tester. W. C. Wilharm. *Ind. and Eng. Chem.*, 1926, **18**, 463-467.

The part played by the "oiliness" of a lubricant is discussed and a sensitive inclined plane apparatus for measuring "oiliness" is described. With brass and steel surfaces it is evident that there are appreciable differences between common lubricants which are not shown in the tests usually made. Conclusions regarding the property of "oiliness" are drawn from the static friction tests made on the apparatus. —B.C.I.R.A.

Lubricant Testing Apparatus. E. G. Gilson. *Ind. and Eng. Chem.*, 1926, **18**, 467-470.

An apparatus is described for determining the factors influencing lubrication, and the

effect of running a bearing in different atmospheres, including air, vacuum, oxygen, hydrogen, &c., was investigated. The results indicate that the surrounding atmosphere has a very decided effect on friction, friction being a minimum in the presence of oxygen. The temperature control was sufficiently accurate to eliminate the possibility of ascribing differences in friction to viscosity differences due to changes in temperature. It is concluded that for efficient lubrication some kind of reaction is necessary which is dependent on the presence of moisture and of oxygen. —B.C.I.R.A.

Lubricant Film: Thickness. A. E. Becker. *Ind. and Eng. Chem.*, 1926, **18**, 471-477.

An apparatus for measuring the film thickness of a lubricating film in a bearing is described. Essentially, two plane bearing surfaces are mounted parallel to and at a short distance from one another, the lower one being suitably mounted and the upper one forming the base of a spindle electrically driven. A leading-in wire is attached to the lower element and electrical contact is made between the spindle and the frame of the apparatus through a mercury cup. When the oil film is introduced the test bearing becomes an electrical condenser and its capacity at rest and when the spindle is in motion is measured by connecting the two elements to one arm of a Wheatstone bridge with sensitive telephone detector. From the capacity, the dielectric constant of the oil and the area of the bearing surface (diam. 0·5 in.) the thickness of the film can be calculated from the usual condenser equation. Data obtained with the apparatus for the four types of bearing, (1) lubricant adhering to both elements, (2) lubricant adhering to the moving but not to the stationary element, (3) the reverse of (2), (4) lubricant adhering to neither element, are shown graphically and a general expression for the film thickness is given in terms of speed, load, viscosity of the lubricant at the working temperature and four constants. The latter depend on the oil and the bearing surfaces used. Accordingly, film thickness is dependent on surface action as well as on viscosity. —B.C.I.R.A.

Lubrication. R. von Dallwitz-Wegner. *Kolloid Z.*, 1926, **38**, 193-208.

The paper deals with the problem of lubrication from the thermodynamic-molecular point of view. The relationship which must hold for efficient lubrication between the cohesive force of the metal, the wetting force set up in the film by molecular attraction from the cohesive force of the metal, and the angle between the oil and the metal surface is worked out. —B.C.I.R.A.

(E)—Transport

Textile Porterage Machines. E. T. Bennington. *Text. World*, 1926, **69**, 79-83.

In an article dealing with the design of equipment for handling textile goods, types of machines for handling cotton bales, warp beams, and cloth rolls are illustrated. —B.C.I.R.A.

Stock (Loose Fibre) Conveying Systems. *Text. Col.*, 1926, **48**, 410-411.

A discussion of the costs and machinery for conveying loose wool within woollen mills by pneumatic methods. —A.J.H.

(F)—Lighting

Textile Mill: Illumination. R. A. Palmer. *Text. World*, 1926, **69**, 3037, &c.

Recent studies and progress in mill illumination are discussed. Tests made in a dress fabric mill showed an increase in production of 25% under modern lighting conditions. The inside-frosted lamp is said to be the most important advance of the last year. The frosting diffuses the light and reduces the possibility of glare. —B.C.I.R.A.

Textile Mills: Illumination. J. J. McLaughlin. *Text. World*, 1926, **69**, 1081-1083.

New types of lamps, reflectors, and lighting equipment which contribute to the better illumination of textile mills are described. —B.C.I.R.A.

Illumination. M. Luckiesh and F. K. Moss. *Sci. Abs.*, 1926, **29B**, 198 (from *J. Franklin Inst.*, 1925, **200**, 731-737).

From experiments on the effect of diversity of field brightness on visual performance, details of which are given, it is concluded that the "average illumination" over a certain area may be a very misleading figure for denoting the effectiveness of a lighting system. High constrasts in brightness in the visual field reduce the speed of visual work. For example, the performance is better when the field brightness is uniform at 5 millilamberts than when one half of the field is four times as bright as this, the other half remaining the same. —B.C.I.R.A.

Illumination. L. L. Holladay. *J. Opt. Soc. Amer.*, 1926, **12**, 271-319.

A summary is presented of the results obtained in an extensive research on the influence of glare on visibility. Visibility was studied chiefly by the method of least perceptible contrasts of brightnesses. Results are presented showing the influence of adaptation and of form and size of test-object on contrast sensitivity. The results of the investigation show that the least perceptible brightness-difference between an object and its background increases directly with the illumination at

the eye from the dazzle source, varies approximately inversely with the square of the angle which the glare-source makes with the line of vision, and is practically independent of the brightness, size, type, distance, &c., of the dazzle source. Considerable study has been given to the variations of the pupil under steady, fluctuating, and glaring lights, and of their influence on vision. Results of the investigations upon irradiation, after-images, blinding-glare, and light-shocks are also presented. —B.C.I.R.A.

Light: Reflection and Transmission. L. Bloch. *Z. angew. Chem.*, 1926, **39**, 615-616.

A report of a lecture demonstration. The author showed that the phenomenon by which a red body in green illumination appears black is due to the reflecting powers of colours and is not a case of complementary colours. In investigations of reflection and transmission of light through different materials aluminium was found to give rise to different reflections. According to whether brightly polished aluminium, a mirror reflecting surface, a disc with a matt aluminium surface, or even black plate covered with aluminium bronze is used, complete reflection, directed reflection: or more or less diffuse reflection is obtained. The difference in the reflecting powers of white-lined and non-lined lamp shades was demonstrated and also the relative transmission of clear and opaque glass, &c. —B.C.I.R.A.

(H)—Humidification

Weaving Shed: Humidification. Textile Operating Executives of Georgia. *Cotton* (U.S.), 1926, **90**, 532.

The relation between humidity and temperature and the value of automatic control of both factors is discussed. —B.C.I.R.A.

Liquid Drops: Absorption of Gases: Air: Humidification. W. G. Whitman, L. Long, and H. Y. Wang. *Ind. and Eng. Chem.*, 1926, **18**, 363-367.

In connection with the operation of sprays for washing and scrubbing gases, experiments have been made on the absorption of carbon dioxide and of ammonia by drops of water falling freely through the gases, and on the humidification of dry air. The absorption of carbon dioxide, when treated as an instance of liquid film diffusion, gives an average rate of absorption coefficient of 260 grams of gas absorbed per hour through 1 sq. cm. of interface with a unit driving potential expressed in grams of carbon dioxide per c.c. of solution. The absorption of ammonia is considered as an example of gas film diffusion and gives a coefficient of 22 grams of ammonia absorbed per hour through 1 sq. cm. of interface with a unit driving potential expressed as partial pressure of ammonia in atmospheres. The humidification of air is also treated as gas film diffusion, giving a value of 18 in the same units. These coefficients are higher than those reported for absorption through flat liquid surfaces, from rising gas bubbles, or in wetted-wall columns. The ratio of liquid film to gas film coefficients is about the same as the ratio obtained with gas bubbles and wetted-wall columns. —B.C.I.R.A.

Artificial Silk Mill: Humidification. J. Obermiller. *Kunstseide*, 1926, **8**, 90-92.

A short article in which the author deals with the importance of controlled humidity in the manufacture of artificial silk and emphasises the fact that it is relative humidity, not absolute humidity which is the influencing factor. Reference is made to methods of control previously described, and the hair hygrometer is recommended for determining relative humidity. —B.C.I.R.A.

(I)—Ventilation

Dyehouse Ventilating System. G. H. Thomson. *Text. World*, 1926, **69**, 1673.

An installation is described for removing steam from the dyehouse atmosphere. The essential parts are a series of rotary ventilators and steam turbine driven blowers equipped with heating surfaces. —B.C.I.R.A.

Textile Mills: Ventilation. C. L. Hubbard. *Text. World*, 1926, **69**, 75-79.

The requirements necessary for good ventilation in textile mills are discussed. —B.C.I.R.A.

Patents

Air Conditioning Apparatus. Aerozon Air Conditioning Co. Ltd., W. T. Pratt, and H. W. J. Lipscombe, Westminster. E.P. 251,001.

Means for controlling the condition of air in a treating, storing, work or like room of a building is actuated by an element, such as a band of copper, ebonite or cotton, sensitive to temperature or humidity changes and located in a tube or casing placed in the room, and means are provided to circulate the air in the vicinity through the tube and past the element. The element is clamped at its ends to blocks and passes over a pulley arranged in a tube through which air is circulated either by a fan or by a divergent jet of gas issuing from a nozzle. One block is connected through two pivoted levers to a terminal and the end of the second lever remote from the pivot is provided with an adjustable contact stud adapted to engage either of a pair of pivoted contact arms, each of which is connected to a terminal. The

three terminals are connected to a double solenoid which controls a cock in a pipe supplying liquid to an air-conditioning apparatus such as is described in Specification 220,703. —B.C.I.R.A.

Cooking Vessel Temperature-control Device. F. T. Lambert, London, and I. G. Perrett, Osterley, Middlesex. E.P. 251,469.

In automatic means for controlling the heat supplied to cooking apparatus, boilers, &c., in which liquid is heated by gaseous or liquid fuel and the burner is controlled by a flexible diaphragm subjected to the pressure of the steam or vapour, an air leak is provided which closes after the air has been driven out under influence of the steam or vapour pressure. The water bath of the cooker is heated by a gas-burner, the supply to which is regulated by a grooved plunger actuated by a diaphragm, the lower side of which is subjected to the steam pressure through a tee-piece, also connected to a cylinder containing a safety valve. The valve rests on a seating and is hollowed to receive a ball. When heating commences air escapes through a hollow stem, but when the generation of steam is too rapid to escape through an orifice the ball is carried upwards against its seating and the steam pressure is caused to act on the diaphragm until the safety valve is raised from its seating. On cooling, the ball drops and readmits air, thus preventing a sub-atmospheric pressure from being established in the boiler. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Lubrication—

250,886. A. Lees & Co. Gravity-feed lubrication device for spindles, &c.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Artificial Silk Production in the U.S.A. D. G. Woolf. *Text. World*, 1926, **69**, 839-840.

Possibilities in the future development of synthetic fibres are discussed and the 1925 production and development and 1926 plans of the chief firms manufacturing artificial silk are surveyed. The year 1925 established a record in production. —B.C.I.R.A.

American Cotton Crop Reports: Improvement. J. A. Todd. *Text. World*, 1926, **69**, 845-846.

Critics of the cotton crop reports of the U.S. Department of Agriculture should remember that the reports are merely indications of the state of the crop at the time. The Bureau reports for the 1925 season have, therefore, been valuable since they quickly noted and reported a succession of remarkable changes in the crop outlook. The following suggestions are made for the improvement of the reports—(1) That only conditions, par values, and indicated yields be published during early months, (2) that by October 18th a revised estimate of acreage planted and acreage abandoned be published, thus making possible a more accurate preliminary estimate of acreage harvested, (3) final figures of acreage planted and harvested for the preceding season should be published in March instead of June. —B.C.I.R.A.

Raw Cotton: Spot Prices. L. H. Haney. *Text. World*, 1926, **69**, 1659.

The *Textile World* analysis of 6th March indicates the predominance of bearish factors and the likelihood of much cheaper spot cotton in May. While it may take several months to work out, it is believed that cotton is nearing an attractive price level and that consumption will be encouraged as a result. This will eventually stimulate cotton manufacturing activity and bring it more into line with the general level of basic industries. —B.C.I.R.A.

Round Cotton Bale: Application. *Text. World*, 1926, **69**, 1997.

Round bales formed about 10% of the American crop in 1902; there was a steady decrease until 1914, since when round bales have increased in number to 314,325 out of a total of 13,796,561 bales in 1924-1925. Practically all were baled by the Clayton press, and the Bessonnette system used about 20 years ago now seems to be obsolete. —B.C.I.R.A.

Cotton Crop in the U.S.A.: Acreage Forecasting. B. B. Smith. *Exp. Sta. Rec.*, 1925, **53**, 592 (from *J. Amer. Statis. Assoc.*, 1925, **20**, No. 149, pp. 31-47, Figs. 2).

The factors influencing the farmers' opinions as to crop probability are outlined, and methods of determining the quantitative relation existing between these factors and the acreage planted are presented. Examination of the coefficients of determination indicated that the price series were more important than the production and yield value in determining the producers' mind than the other factors. January and February were found to have probably closer relation to acreage than other months except November. —B.C.I.R.A.

Cotton Cultivation in Paraguay. T. Bühler. *Leipzig. Woch. Text.-Ind.*, 1926, **41**, 383-384.

A review of cotton growing possibilities in Paraguay. The harvest increased from 90 bales in 1916-17 to 16,000 bales in

1923-24, falling to 13,000 bales in 1924-25. An average yield of 380 kg. per hectare is claimed (as compared with an average yield of 216 kg. per hectare for the U.S. in 1909-14). *G. barbadense* (staple length 1½ in.) and *peruvianum* are native; Upland short staple attains a staple length in Paraguay of 1¼-1⅜ in. The average crop is between U.S. good middling and strict middling. Cotton growing is under the auspices of the Banca Agricola in Asuncion and is subject to statutory control.
—B.C.I.R.A.

Artificial Silk Production in Germany. *Kunstseide*, 1926, **8**, 60-63.

The present position of artificial silk manufacture in Germany is discussed. The principal manufacturers are named.
—B.C.I.R.A.

Cotton Production in 1925-26. *Int. Cotton Bull.*, 1926, **4**, 275 (from *U.S. Bureau of Agric. Economics*).

Preliminary estimates for the 1925-26 acreage compared with 1924-25, show a 9·2% increase for certain countries comprising about 85% of the total acreage. An increase in production of 11·1% over 1924-25 is also indicated. —B.C.I.R.A.

Cotton Production in U.S.A., 1924. *Dept. Commerce, Bureau of Census*, 1925.

The following data are recorded—

1—Comparative Summary—Cotton and Linter Production: Crops 1899-1924.

2—Production of cotton and linters by States: 1921-1924.

3—Cotton ginned to specified dates throughout the season by States: 1921-1924.

4—Per cent. of the total cotton ginned to specified dates by States: 1921-1924.

5—Average gross weight of bales by States: 1921-1924.

6—Number of ginneries in 1924 and quantity of cotton ginned from the crops 1922 to 1924 by counties.

7—Cotton ginned to specified dates and total for the season; by counties: crop of 1924. —B.C.I.R.A.

Cotton Variety Tests in U.S.A. (Oklahoma). G. Briggs. *Exp. Sta. Rec.*, 1925, **53**, 435 (from *Oklahoma Sta. Bul.*, No. 154, 1925, 3-12).

Acala No. 5, Oklahoma Triumph 44, Mebane, and Lightning Express were the leading varieties in money value per acre at the station in 1924. These, and Rowden, Trice, and Rivercrest showed up well in co-operative tests in different parts of the State during three years.
—B.C.I.R.A.

Hemp Growing in Germany: Economic Phases. See Section Ic.

10—MISCELLANEOUS

North Carolina State College: Research Programme. E. C. Brooks. *Amer. Dyestuffs Rep.*, 1926, **15**, 158-162.

Some account is given of the work done in training textile technologists at the North Carolina State College of Agriculture and Engineering. A number of research problems are mentioned, including an inquiry into the chemical changes in cotton during storage, which is intended to determine the value of "curing" cotton before ginning. —B.C.I.R.A.

Clothes Moth: Killing by Vacuum. E. A. Back and R. T. Cotton. *J. Agric. Res.*, 1925, **31**, 1035-1041.

The authors investigated the use of high vacua for the control of insects, and they have tabulated the effect of a vacuum varying from 26 to 29 inches on eggs, larvæ, pupæ, and adults kept in a bell jar of 825 cubic inches capacity for periods up to seven days. An exposure of 24 hours was fatal to a great number of insects treated. The common clothes moth *Tineola biselliella* showed much resistance, but a treatment of 3-7 days sufficed to kill the four stages from eggs to adults.
—B.C.I.R.A.

Cottonseed Gossypol: Properties. F. W. Sherwood. *J. Agric. Res.*, 1926, **32**, 793-800.

Brief notes are given describing the cooking of cotton seed preparatory to making cottonseed meal. The content of gossypol and *d*-gossypol in 40 samples of N. Carolina cottonseed meal are reported and it is shown that about 75% of the gossypol originally in the cotton seed is converted into the less toxic *d*-gossypol on cooking.
—B.C.I.R.A.

Moth Prevention: History and Prevention. A. P. Sachs. *Text. Col.*, 1926, **48**, 453-456.

The first part of the article dealing with the life history of moths capable of damaging textile materials. —A.J.H.

Monel Metal: Application. *Text. World*, 1926, **69**, 1937-1964.

An advertisement showing the complete range of utensils and machines now made in Monel metal for the textile industries.
—B.C.I.R.A.

Elementary Cotton Growing Lessons. F. A. Merrill. *U.S. Dept. Agric. Miscellaneous Circular No.* 43, 26 pp., 14 Figs., Aug., 1925.

A course of lessons for children residing in cotton growing areas is designed to follow the seasonal activities and to familiarise the pupils with modern farming, grading, ginning, and marketing methods.
—B.C.I.R.A.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Sericulture in Portland, Oregon *Silk J.*, 1926, **2**, No. 21, p. 66.

The Columbia Silk Farm reports that worms thrive there as well as they do in China or Japan; 80,000 worms were fed during 1925, and with the feeding of 400,000 this year it is expected that the enterprise will be placed on a paying basis. —F.G.P.

(C)—Vegetable

Cotton Anthracnose: Control. S. G. Lehman. *Rev. App. Mycol.*, 1926, **5**, 90 (from *North Carolina Agric. Exp. Sta. Tech. Bull.*, 1925, No. 26, 71 pp.).

A detailed account of investigations on the control of cotton anthracnose by heat treatment of the infected seed. In a machine for treating cotton seed in bulk with dry heat the effective treatment for the control of anthracnose without serious reduction of germination consists of 20 to 24 hours' desiccation at 60 to 65°, followed by 12 hours' heating at 95 to 100° C. The moisture content of cotton seed was found to be a decisive factor in its ability to withstand temperatures effective in anthracnose control. When the moisture content after drying amounted to 3·9% of the oven-dry weight, the viability of the seed was seriously impaired by 12 hours' heating at 95°. When the moisture content did not exceed 3·62% of the dry weight there was no serious loss of activity. When the water content was not greater than 3·19% the seeds heated at 95° for 12 hours germinated more rapidly than untreated seed. The control of the fungus by dry heat is due, not to desiccation, but to the direct action of the heat on the protoplasm of the organism. —B.C.I.R.A.

Boll Weevil Control in S. Carolina. G. M. Armstrong, R. W. Moreland, and R. C. Gaines. *Rev. App. Entomol.*, 1926, **14**, Ser. A, 74 (from *S. Carolina Agric. Exp. Sta. Bull.*, 1925, No. 223, 64 pp.).

Calcium arsenate dust, applied after 10% of the squares were found to be punctured by the weevil, made 2·6 times the increase of seed cotton that was made with the Florida method, 3·1 times that with one pre-square application of molasses mixture, 1·6 times that with molasses mixture applied with both mop and sprayer, and 2·2 times that with molasses mixture applied with a mop throughout the season. Early applications of calcium arsenate dust, both of which were followed by calcium arsenate dust after 10% infestation, made practically the same increase of seed cotton as calcium arsenate dust applied after 10% infestation. One pre-square application of molasses mixture followed by calcium arsenate dust after 10% infestation made 2·8 times the increase of seed cotton that was made with one pre-square application of molasses mixture alone. One pre-square application of calcium arsenate dust followed by calcium arsenate dust after 10% infestation made 2·2 times the gain of seed cotton that was made with one pre-square application of calcium arsenate dust alone. Molasses mixture applied with both mop and sprayer, and nicotine dust made practically the same increase of seed cotton.—B.C.I.R.A.

Cotton Anthracnose: Control. C. A. Ludwig. *Bot. Abs.*, 1925, **14**, 1392 (from *South Carolina Agric. Exp. Sta. Bull.*, 1925, No. 222, 1-52).

Anthracnose (*Colletotrichum Gossypii*) is one of the most important cotton pests and occurs in most of the cotton growing regions of the world. It is largely transmitted, from season to season, by infected seed. Attempts to develop a quick, practical method of destroying the fungus in the seed have not been successful. Effective control measures consist of such means as the selection of seed from healthy stalks not growing near diseased ones, ploughing in of diseased stalks in the fall or following a rotation, ginning in a clean gin, delinting with strong sulphuric acid, and storing infected seed for at least two years before planting to allow the fungus to die. The experimental work reported is a study of some of the environmental features which affect the life of the fungus in stored, infected seed. The results show that the seed becomes free of infection in storage. Under laboratory conditions the action proceeds very slowly at first but becomes rapid when the seed is about a year old. By the second spring after picking, the infection has practically disappeared. Storage in a very moist atmosphere leads to the early death of the fungus, but the seed becomes musty and fails to germinate. Storage in a very dry atmosphere greatly prolongs the life of the fungus. Alternate storage in very dry and very moist air was of no advantage. Delinted and sterilised seed has the initial infection cut down to a low figure and that remaining in the seed seems to become eliminated a few months sooner than in untreated seed. —B.C.I.R.A.

Flax Growing in South Dakota. A. N. Hume, E. W. Hardles, and C. Franzke, *Exp. Sta. Rec.*, 1926, **54**, 34 (from *S. Dakota Sta. Bull.*, 1925, No. 213).

The information and experimental data presented supplement those recorded earlier. Further tests at Highmore

Cottonwood, and Eureka indicated April 15 as the best seeding date for highest yields. A rate of not less than 20 qt. per acre is suggested. During two years one acre seeded to clear flax produced a larger total yield of flax than did two acres seeded in mixture with wheat, while the reverse was true with wheat. The combined production from two acres seeded in flax-wheat mixture was greater in both years than where flax and wheat were seeded separately, each on one acre. Greater gross financial receipts for flax came from one acre of clear flax seeded along with one acre of clear wheat than from the flax in two acres of flax-wheat mixture, whereas the opposite was true of wheat. The highest gross financial return in the experiment was received from land seeded into flax-wheat mixture in 1924, and the highest average return in the two years came from land seeded in flax-wheat mixture. The usual records of the annual precipitation by months at the station and sub-stations are appended. —L.I.R.A.

Cotton Boll-rotting Bacteria. J. C. Hopkins. *Ann. App. Biol.*, 1926, **13**, 260-265.

Two organisms have been isolated which are capable of producing an internal rot of at least five varieties of cotton bolls. Inoculation experiments and resulting physiological phenomena are described and the similarity between the two rots demonstrated. The association of one organism with the anthracnose fungus is pointed out and dual infection of a number of varieties of cotton bolls discussed; the resistance of Sea Island and Cauto varieties to the disease is suggested. Detailed descriptions of both organisms and their reactions to various standard media are given. —B.C.I.R.A.

Cotton Cultivation in Brazil. B. G. C. Bolland. *Ann. App. Biol.*, 1926, **13**, 266-273.

The paper gives an account of the formation of the cotton service in Ceara, one of the north-eastern states of Brazil, the lines on which the work of improving the cotton crop is to be conducted and some figures showing the composition of the crop prior to any selection. Because of the large number of types represented and the long period of time during which cross-fertilisation has taken place, several years must elapse before any pure selected strains can be marketed. —B.C.I.R.A.

Photoperiodic Plants and Cotton Plant: Effect of Temperature and Humidity on Vegetative Activity. B. E. Gilbert. *Ann. Bot.*, 1926, **40**, 315-320.

This paper is an account of the results obtained with certain plants, known to respond to relative day length, when grown under two controlled sets of temperature and humidity. The plants investigated included cotton as likely to be very sensitive to temperature variations. Marked results were obtained in the modification of the length of the vegetative activity. Soya beans and cotton exhibited definite reactions to the higher temperature and lower humidity conditions. Definite retardation of flowering was noted with the lower temperature and higher humidity conditions. *Cosmos* was definite in reaction, but *Salvia* and Buckwheat exhibited no reaction. —B.C.I.R.A.

Seed Pods and Vegetable Fibres: Flexion. S. Rywosch. *Biochem. Z.*, 1925, **166**, 24-46.

Observations on the curling of seed pods and vegetable fibres in water and under varying conditions of humidity show that flexion depends, not only on the difference between the rates of imbibition or desiccation of the hygroscopic organs on each side of the tissue, but also on the degree of swelling of the tissue as a whole. The rate of imbibition depends on the permeability of the epidermal layer and the humidity of the atmosphere, and the degree of flexion is also influenced by the pressure to which the layer of cells on the concave side of the tissue is subjected by the swelling of the cell-layer on the convex side. —B.C.I.R.A.

Kapok: Application. *Bull. Imper. Inst.*, 1926, **24**, 18-36.

A survey of the production of kapok, its cultivation and uses. —B.C.I.R.A.

Weeds; Diluted Sulphuric Acid as a Spray for——. A. Aslander. *Bot. Abs.*, 1926, **15**, 674 (from *Nordisk Jordbrugsforskning*, 1925, 126-146).

Used at a rate of 90 gallons per acre 2% sulphuric acid killed plants of *Sinapsis arvenis* with 3-4 leaves, while plants which had wintered over in the field required a 5% solution. The acid penetrates into the plant, killing the protoplasm, and destroying the chlorophyll and chloroplasts. In winter-grown leaves the thick cell walls will absorb a considerable quantity of acid and the lower layers eventually escape killing. Barley, oats, and peas are protected by means of a wax coating; red clover, by hairs. The leaves of *Chenopodium album* are protected by glandular hairs, but the plants may be killed when the field is rolled previous to spraying, by which procedure the unprotected stems are killed. Added to water cultures sulphuric acid in concentrations no stronger than 1-20,000 seems harmless. —L.I.R.A.

Cotton Variety Trial in U.S.A. (Arkansas). J. O. Ware. *Exp. Sta. Rec.*, 1926, **54**, 33 (from *Arkansas Sta. Bull.*, No. 197, 1925).

Early varieties have a somewhat lower ginning outturn and smaller bolls, but they average more lint per acre during a period of years. Gin outturn did not appear a safe criterion for a variety. Earliness

seems necessary for high production under boll weevil conditions, and on the average total yields are proportional to the size of the first picking. Long staple accompanies a lower lint percentage, but as indicated by Express and Delfos not necessarily low yield. Length and quality of lint appear to be affected by soil and season.

—B.C.I.R.A.

Cotton Seed: Disinfection. E. Ferreira. *Chem. Abs.*, 1925, **19**, 3345 (from *Gaceta Algodonera*, 1924, **1**, 21-25, and *Rev. internat. renseign. agric.*, 1925, **3**, 556-557).

The author concludes from the results of tests in which he used 400 grams of carbon disulphide per cu. m. of seed for 24 hours, that the carbon disulphide treatment in no way injures the germinative power of the seed. It prevents fermentation of weak seeds which, though they do not germinate, might cause the development of a harmful vegetation. Disinfection should be carried out a short time before sowing; the seed should be quite dry and quite ripe when disinfected. The method of determining germinative power is described.

—B.C.I.R.A.

Egyptian Cotton: Effect of Summer Fallow. E. McK. Taylor. *Ministry Agric. Egypt, Bull.* No. 57, 1926.

The yield from land which has been subjected to a long summer fallow is considerably greater than that from land which has had a short summer fallow. The theory that the decline in the yield of Egyptian cotton is directly attributable to the fact that the summer fallow period has been almost entirely eliminated is confirmed. As this elimination is largely due to the early sowing of maize, the postponement of the sowing date of maize until about August 10th is suggested. The water now stored in the Aswan Dam is used to supplement the early stages of the flood in July. It has been shown that it is economically possible to employ this water in ensuring the rice crop in the northern areas. The loss on the maize crop to the fellah in the south by this alteration would be compensated for by an increased yield of cotton. The prosperity of the northern portion of the Delta would be considerably increased as the result of the increase in the available water.

—B.C.I.R.A.

Soil Heterogeneity and the Use of Probable Error Concept in Plant Breeding Studies; Control of——. H. K. Hayes. *Bot. Abs.*, 1926, **15**, 727 (from *Minnesota Agric. Exp. Sta. Tech. Bull.*, 1925, **30**, 3-21).

A method of computing an average probable error for the experiment which was called "the deviation from the mean method" was given. Essentially the same method was used as in the ordinary formula for standard deviation, except that the deviation of each plot of each variety from the variety mean was expressed in percentage. Similar results were obtained as by the use of numerous check plots of a standard variety distributed systematically throughout the experimental field. Various methods were tried of using calculated probable errors as a means of estimating the significance of the results. The deviation of the mean and Student's method were compared. A method was given of computing a coefficient of soil heterogeneity when conducting a strain or variety test.

—L.I.R.A.

Cotton Cultivation in S. Africa. G. F. Keatinge. *Emp. Cotton Grow. Rev.*, 1926, **3**, 193-199.

Suggestions are made as to the means of developing a stable cotton growing industry in Swaziland, Transvaal, Natal, and Portuguese East Africa. Cultivations, pests, rotational cropping, and alternative crops are discussed.

—B.C.I.R.A.

Cotton Cultivation in Papua. G. Evans. *Emp. Cotton Grow. Rev.*, 1926, **3**, 200-214.

A survey of Papuan cotton growing possibilities leads to the conclusion that the dry belt lying to the East and West of Port Moresby has a normal rainfall suited to cotton growing and the necessary dry season for harvesting. Disappointing results with Upland American in 1925 were partly due to abnormally heavy rains in April and May and partly to the lack of experience among the cultivators. Pest damage in all instances was severe. Sea Island and Kidney cotton are thought worth trial. Seed treatment against pink bollworm is essential and a closed season of three months must be instituted. Recommendations for the organisation of the agricultural department and for the appointment of an entomologist are made.

—B.C.I.R.A.

Cotton Cultivation in New Guinea. G. Evans. *Emp. Cotton Grow. Rev.*, 1926, **3**, 215-234.

The climate is generally unsuited to cotton growing on account of the excessive and evenly distributed rainfall and the high atmospheric humidity. There is, however, a dry area in the Markham Valley, possibly 1,000 square miles in extent, which may prove climatically suitable. Preliminary trials with Durango are encouraging but because of uncertainty as regards climate, seed distribution to the natives is undesirable until thorough tests have been made. Selection work on native varieties is recommended. The Sea Island variety also deserves trial. Precautions should be taken to see that all introduced seed has been efficiently treated prior to entering the valley in order to prevent infection with the pink bollworm.

—B.C.I.R.A.

Cotton Cultivation in U.S.A. (N. and S. Carolina). W. Brown. *Emp. Cotton Grow. Rev.*, 1926, **3**, 268-275.

Generally throughout the U.S.A. belt, new strains are sought by straight selection from the almost endless series of cotton varieties already existing, and hybridisation is less in favour because it takes seven years longer to establish a chosen strain. Nakedness of the seed was once held to have certain disadvantages over fuzziness, but now nakedness is sought because of easier disinfection and sowing and of earlier germination, which are useful qualities where pests are serious. The first results on the inheritance of fuzz indicate nakedness as dominant. Wet years and wet situations favour the boll weevil and rank growth, overcrowding, horizontal and low branching favour attack. Early maturing, maximum bolling in the early season, rapidly growing and hardening bolls are desirable characteristics in new selections, and cultivations are adapted to reduce shedding of early bolls, to encourage upright growth with few spreading branches and to develop smaller but more numerous plants to the row, and to allow the maximum exposure of the soil to sunshine. The Florida method is to some extent effective against the weevil, but it is expensive in comparison with calcium arsenate dusting. The Dixie variety was resistant to wilt but late for boll weevil, and the Dixie Triumph cross was made to correct lateness. It was fixed in 1919, nine years after the original hybridisation, and is now grown on the light sandy soils where wilt is prevalent. Immune cow peas and the velvet bean are useful rotation crops for wilt land, but on wilt-free soils the soy bean has preference. —B.C.I.R.A.

Cotton Pests Control in Queensland. E. Ballard. *Emp. Cotton Grow. Rev.*, 1926, **3**, 276-279.

An account of the means adopted to counteract pest attack in the 1925-26 cotton growing season. —B.C.I.R.A.

Cotton Production in Peru. *Internat. Cotton Bull.*, 1926, **4**, 383-392.

The 35 separate cotton growing valleys included in the official Government list fall naturally into three areas, namely, the Piura and Chira Rivers in the Department of Piura, the central coast region from Chimbote to Ica, and in the extreme south the Camana, Majes Ocona, and Tambo valleys in the Department of Arequipa, and the Moquenqua district. The second and third areas are practically continuous, but are separated because of the far greater production of the central portion. Cotton does not thrive well north of the Santa River (near Chimbote) until the Piura is reached, sugar and rice being the substitute crops. Each valley has its peculiar characteristics and there is considerable variation in seasons, varieties, and average yields. The distribution and the quantity of each type grown, the climatic conditions, methods of cultivation, labour conditions, pests, ginning production costs, markets and export taxes are all discussed. —B.C.I.R.A.

Cotton Production in Puerto Rico. *Internat. Cotton Bull.*, 1926, **4**, 392.

The 1925 crop amounted to 1,930 bales, or about twice the exports of the previous year. A dry spring interfered with planting, but pink bollworm was not serious. Highly successful trials were made for the first time in Bayamon and Comerio. —B.C.I.R.A.

Cotton Cultivation in India (Sind). T. F. Main. *Internat. Cotton Bull.*, 1926, **4**, 403-411.

The uncertainties of cotton cultivation under the old irrigation system are detailed; and the prospects of cotton growing in the area commanded by the Lloyd Barrage Irrigation Scheme are discussed. Early attempts to improve the quality of production by the introduction of exotics are reviewed; and the required characteristics for successful varieties in Sind conditions are given. —B.C.I.R.A.

Cotton Cultivation in Java. *Textielind.*, 1924, **5**, 151-152.

The main factors which are considered to have hindered cotton growing in Java are unsuitable climate and insect pests. The chief pest is the stem and boll borer which is a concealed enemy, but leaf caterpillars appear more or less commonly and, in isolated cases after a long drought, the white aphis. The stem borer comes at the beginning of the rainy season to young shoots of mature cotton plants and bores into the stems causing the tips to die off. The insecticides employed against the coffee bean pest in Java are effective. The boll-borer is similar to the stem-borer and can be similarly treated. If spraying is done in time the borer can be prevented from reaching beyond the first loculus of the boll, and the remaining loculi ripen normally. The climate is less unfavourable to mature cotton plants than to first year growths, and the possibility of cultivation from suckers, &c., is discussed. Plants were seen which produced 200 bolls with a cotton weight of 2 grams and a seed weight of 6 grams per boll. The yield per acre on an experimental plantation is high. —B.C.I.R.A.

Cotton Cultivation in Trinidad. *Tropical Agric.*, 1926, **3**, 119.

Experiments are discussed in which an area of about ¾ acre of ground of low fertility (previously in abandoned savannah and scrub) was put under Sea Island cotton. The bank method of cultivation was employed and a minimum of after-cultivation was practised. Of the six spacings adopted, the widest, 24 in., gave the lowest yield

and the closest, 12 in., gave the highest. The yields were at the rate of 1,210 lb. and 1,575 lb. of seed cotton per acre respectively, the difference being statistically significant. There was no marked difference between the yield obtained by direct planting at 12 in. and that obtained by continuous planting and subsequent thinning out to 12 in., on the appearance of the first flower bud. —B.C.I.R.A.

Seedling Cotton: Inherited Chlorophyll Deficiency. S. C. Harland. *Tropical Agric.*, 1926, **3**, 150.

The two types of chlorophyll deficiency have been observed in the second generation of Acala (Upland) by Pima (Egyptian) crosses. Two yellow seedlings have been raised to the flowering stage and will be crossed with Upland and Egyptian respectively. —B.C.I.R.A.

Cotton Cultivation in Cuba. *Tropical Agric.*, 1926, **3**, 150.

It is reported that a very satisfactory cotton is being grown on a trial scale, and that it is intended to increase the area very considerably if the pests can be controlled. The pests at present met with are the Mexican boll weevil (*Anthonomus Grandis*) and the cotton stainer (*Dysdercus ondræ*). Other species of *Dysdercus* are known to occur in Cuba. —B.C.I.R.A.

Pink Bollworm and Cotton Stainers Control in Papua and New Guinea. E. Ballard. *Rev. App. Entomol.*, 1926, **14A**, 206 (from *Queensland Agric. J.*, 1926, **25**, 23-30, and 53-55).

Accounts of the binomics and control of the pink bollworm in Papua and New Guinea and of cotton stainers and the harlequin bug in New Guinea. —B.C.I.R.A.

Pink Bollworm Control in U.S.A. (Texas). *Rev. App. Entomol.*, 1926, **14**, Ser. A, 294 (from *Qtrly. Bull. State Plant Bd. Mississippi*, 1926, **5**, 1-3).

There was a general increase in the damage done by pink bollworm in the western irrigated sections of Texas during 1925. The pest has recently been found hibernating in cocoons in the ground where it can withstand frost, snow, and other unfavourable conditions. Infestations occurring at distances of 25 to 40 miles from the previous year's cotton fields are probably due to moths drifting on wind currents blowing from infected areas. —B.C.I.R.A.

Cotton Weevil: Peru. H. S. Barber. *Rev. App. Entomol.*, 1926, 14, Ser. A, 251 (from *Proc. Entomol. Soc. Washington*, 1926, **28**, 53-54).

Eulechriops gossypii is described from Peru, where it attacks the stem of cotton at the surface of the ground. The larvæ bore into the centre of the stalk, causing the plant to fall over. —B.C.I.R.A.

Cotton Stem Borer Parasite in Sudan. J. Waterson. *Rev. App. Entomol.*, 1926, **14A**, 223 (from *Bull. Entomol. Res.*, 1926, **16**, 309-313).

Lathromeris johnstoni, reared from the eggs of the Buprestid *Sphenoptera gossypii* in the Sudan is described. It is found wherever this stem borer of cotton occurs, up to 100 miles south of Khartoum. —B.C.I.R.A.

***Helopeltis SPP.* in Nigeria (S.): Life History.** O. B. Lean. *Rev. App. Entomol.*, 1926, **14A**, 223 (from *Bull. Entomol. Res.*, 1926, **16**, 319-324).

Some observations on the life history of *Helopeltis* in Southern Nigeria where they are minor pests of cotton. —B.C.I.R.A.

***Tectocoris lineola* in Queensland: Life History.** E. Ballard and F. G. Holdaway. *Rev. App. Entomol.*, 1926, **14A**, 223 (from *Bull. Entomol. Res.*, 1926, **16**, 329-346).

A paper on the life history of *Tectocoris lineola* and its connection with internal boll rots in Queensland. —B.C.I.R.A.

Boll Weevil Control in India. F. P. Mackie. *Rev. App. Entomol.*, 1926, **14A**, 233 (from *Rep. Bombay Bact. Laby.*, 1924, pp 30-31).

Tests have been made with hydrogen cyanide gas with a view to fumigating American cotton to prevent the introduction of the boll weevil into India. Various native weevils were used including *Calandra*, which proved the most resistant. The time of exposure appeared to be of greater importance than the concentration of the gas; thus all individuals of this weevil were killed after exposures for 19 hours or more to a concentration evolved from ½ oz. each of sodium cyanide and sulphuric acid, whereas concentrations obtained with 1 oz. had no effect even after 6 hours. With formaldehyde vapour all the weevils were killed in 4 hours by a concentration of 10 parts per 100,000, or in 2 hours by 20 parts per 100,000. Cotton absorbs hydrogen cyanide gas. —B.C.I.R.A.

Cotton Insect Pests in Martinique. *Rev. App. Entomol.*, 1926, **14A**, 240 (from *Agron. Colon.*, 1925, No. 96, pp. 296-298.

A general account. Native cotton is cultivated to some extent, especially in the south and west, but is considerably damaged by insects. The chief pest is *Dysdercus delauneyi*. —B.C.I.R.A.

Cotton Pest in China. F. C. Woo. *Rev. App. Entomol.*, 1926, **14A**, 292 (from *J. Econ. Entomol.*, 1926, **19**, 412-413).

A species of *Boarmia* is a serious cotton pest in China and the possibility of its introduction into the United States is emphasised. —B.C.I.R.A.

Boll Weevil and Aphids: Control. W. E. Hinds. *Rev. App. Entomol.*, 1926, **14A**, 266 (from *J. Econ. Entomol.*, 1926, **19**, 112-121).

A permanent system of agriculture for the cotton belt is now being followed. Dusting by aeroplanes will probably become an important method of boll weevil control in the near future. *Aphis gossypii* can be controlled simultaneously by adding nicotine sulphate to the calcium arsenate dust. —B.C.I.R.A.

Cotton Root Borer in Brazil. G. Bondar. *Rev. App. Entomol.*, 1926, **14A**, 238 (from *Correio-agric.*, 1926, **3**, 241-248).

Notes on the weevil *Gasterocercodes gossypii*, a native of S. America, occurring throughout Brazil. Its larva bores into the roots and underground parts of the stem. —B.C.I.R.A.

Boll Weevil: Dispersion. D. Isely. *Rev. App. Entomol.*, 1926, **14A**, 266 (from *J. Econ. Entomol.*, 1926, **19**, 108-112).

The dispersion of the cotton boll weevil in a field after the hibernating weevils have become established is periodic. Each period of dispersion coincides with the emergence of a new brood of weevils. The spread of weevils across a field is usually direct from plant to plant and row to row, and is not the result of long flights. Newly emerged weevils do not usually migrate until sexual maturity has been attained. This information has been used in locating infestations at the beginning of the second and third periods of dispersion and in timing dust applications. Small infested areas dusted before weevils reached sexual maturity resulted in apparent extermination of infestation. —B.C.I.R.A.

Cotton Flea-hopper in U.S.A.: Distribution. H. H. Knight. *Rev. App. Entomol.*, 1926, **14A**, 266 (from *J. Econ. Entomol.*, 1926, **19**, 106-108).

The natural food plants of the Capsid, *Psallus seriatus*, which has recently been recorded as injuring cotton in Texas and other southern States, are various species of *Croton*, especially *C. texensis*. The adult is described and its distribution in the United States is discussed. —B.C.I.R.A.

Cotton Boll Shedding: Puerto Rico. R. A. Toro. *Rev. App. Mycol.*, 1926, **5**, 299 (from *Rev. Agric. Puerto Rico*, 1926, **16**, 17-18).

The abnormal fall of cotton bolls (up to 20%) in coastal districts of Puerto Rico has been traced to purely physiological causes and is interpreted as a means by which the plant adjusts itself to changes of weather. Should a period of heavy rains, with high temperature and vigorous transpiration, be followed by drought, the plant may find itself with insufficient nutrient to develop completely the flowers produced. Consequently a certain number of bolls are shed so that the rest may mature normally. Suggestions are given for securing conservation of soil moisture as a precaution against boll-dropping. —B.C.I.R.A.

Flax in North America; Browning Disease of——. A. W. Henry. *Rev. App. Mycol.*, 1926, **5**, 302 (from *Phytopathol.*, 1925, **15**, 807-808).

The browning disease of flax was first observed by the writer of Saskatoon, Saskatchewan (Canada) in 1920; and in 1923 it was reported to be capable of causing severe injury in the same locality. The fungus was found to remain viable on diseased leaves for over four years and attention is drawn to the danger of its transmission on infected seed. In August 1925 specimens of flax infected by *P. lini* were received from Michigan. Part of the seed from which this crop was grown came from Ontario. This is believed to be the first record of browning in the United States. The stem break phase of the disease has not been much in evideuce. —L.I.R.A.

"Pasmo" Disease of Flax. W. E. Brentzel. *Rev. App. Mycol.*, 1926, **5**, 365 (from *J. Agric. Res.*, 1926, **32**, 25-37).

The disease of flax and linseed caused by *Phlyctæna linicola* and known in South America under the name of "pasmo" is stated to have been probably introduced some the years ago into the United States with imported seed. During the past three years it has been observed on seed flax at various points in North and South Dakota, Minnesota, and Michigan. The symptoms of the disease and the various stages in the life history of the causal fungus are described in detail. In the author's opinion the disease should be easily controlled in farm practice by seed disinfection with formaldehyde, burning the infected straw, and crop rotation, since the fungus overwinters on the remains of the previous crop and viable spores were also found on the seed. —L.I.R.A.

Egyptian Cotton-894: Development. *Rev. Text.*, 1925, **23**, 1155 (from *Le Phare Egyptian*).

A new cotton has been developed by Parachimonas in Egypt which is said to possess all the good qualities of Sakellaridis without its inconveniences. This cotton is known at present only by the number 894. —B.C.I.R.A.

Improved Indian Cottons; Cultivation of——. *Review of Agricultural Operations in India*, 1924-1925; pub. 1926; pp. 11-23 and 62-63.

Progress in the introduction of improved varieties is reported from all cotton growing districts. Punjab American is now grown on practically a million acres in the Punjab and on 20,000 acres in Sind. Seed for 100,000 acres each of Kumpta and Dharwar American was issued; but in the Dharwar tract owing to the spread of wilt disease

the substitution of Dharwar with immune Kumpta strains is under consideration. In the Central Provinces fungus isolated in a pure state from wilted cotton plants failed to infect healthy plants. It was also observed that wilted plants showed internally the same characteristics as mature plants do when they are reaching the end of their season's life. Trials of Dharwar-American cotton in Hill Tippera, Midnapur, Bankura, and Birbham districts of Bengal are said to have met with some success. —B.C.I.R.A.

Cotton Plant Diseases Occurrence in Sierra Leone. *Rev. App. Mycol.*, 1926, **5**, 345 (from *Ann. Rep. Lands and Forests Dept., Sierra Leone* for 1924; 1926, 17-19).

Angular leaf spot and black arm of cotton were found on the imported Allen's Long Staple variety in several localities. —B.C.I.R.A.

Cotton Cultivation in Uganda. W. H. Himbury. *Text. Merc.*, 1926, **74**, 560-561.

The policy of erecting small ginneries every few miles has not, in the author's opinion, been an entire success. Government control of the cotton industry in Uganda is, for the present at least, necessary. In the Eastern Province, excepting Busoga, the yield per acre is not good and in the Buganda area where it is better it is still low. The low yield is attributed to improper cultivation, faulty selection of land, and general lack of instruction. The quality of Uganda cotton is good. It varies in staple from $1\frac{1}{8}$ to $1\frac{3}{16}$ in. The most fertile soils are in Buganda and the Busoga districts. Uganda has no serious insect pests. Bud, flower, and boll shedding owing to heavy rains and low temperatures is a serious trouble. The weather in Uganda is uncertain and in the Eastern Province severe hailstorms are prevalent. Labour is scarce, but there is, at present, considerable wastage of labour. —B.C.I.R.A.

Kapok. *Text. Rec.*, 1926, **44**, No. 521, pp. 45-46.

A survey of the production of Kapok within the British Empire with notes on its cultivation and uses. The chief producing and exporting country is Java. The hairs of Kapok are cylindrical, 0·6-1·2 in. in length, are very porous and light, have very thin cell walls and being impermeable to moisture are buoyant and therefore especially suitable for upholstery and the manufacture of life-saving appliances. Kapok hairs are weak and owing to their smooth slippery surface are not suitable for spinning. Kapok is obtained from pods of a tree which grows to a height of about 50 ft., but the hairs are attached to the inner wall of the capsule and not to the seeds as in the case of cotton. The pre-war price was 7-9d. per lb.; prime Java Kapok is now 1/3½ per lb. Machinery is employed for separating Kapok from the pods and the resulting fibre is usually graded into four classes—(1) Superior or extra, containing less than 0·5% of seed, (2) prime containing not more than 2% of seed, (3) fair average, with not more than 3·5% of seed, and (4) damaged Kapok. —A.J.H.

Hemp Fibres; Strength and Extensibility of——. W. Muller. *Leipziger. Monats. Text. Ind.*, 1926, **41**, 213-214.

An account is given of an examination of various kinds of fibre, the tensile strength, extension under load, &c., being measured. Specimens of hemp fibre from Russia, Italy, and Yugo-Slavia were found to give real differences in breaking strength, this being due partly to the differences in the material and partly to the methods of dressing. The extension also varied widely. The colour of the hemp was found to have no relation to its tensile properties and a microscopic examination showed that the fibre structure was the same in all specimens. —L.I.R.A.

Cell Membranes: Microscopy and Structure. J. König. *Biochem. Z.*, 1926, **179**, 261-276.

The paper is a summary of previous researches of the author and others on the structure of the cell membrane and the chemical composition of its constituents and decomposition products. Slides are reproduced in which cellulose, lignin, and cutin are clearly distinguishable, and a number of analyses are given. —B.C.I.R.A.

Lignocellulose: Stone Cells of the Pear. C. Dorée and E. C. Barton-Wright. *Biochem. J.*, 1926, **20**, 502-506.

The stone cells of the pear are lignified cellulose resembling in composition the forest woods rather than the annual lignocelluloses such as jute. They consist of 80% lignocellulose which contains 60% cellulose and 20% lignin. The cellulose contains 73% α-cellulose and 27% β-cellulose. —L.I.R.A.

Cell Membranes: Dye Penetration. H. Fischer. *Ber. Deut. Bot. Ges.*, 1926, **44**, 208-212.

Starch flour was placed in Congo Red solution and after periods of 36, 52, and 92 days was found to be paler in colour than the surrounding solution. Cellulose behaves quite differently; cotton wadding is deeply coloured and after 24 hours the colour is deeper than that of the solution. Congo Red penetrates sections of oak wood more slowly; after three days the colour is evident but pale, after 8 days it is, however, intense and deeper than that of the remaining solution which after several weeks is completely decolourised. Congo Red penetrates parchment paper which, according to the micellar hypothesis, has very narrow "interstices," comparatively

readily. The penetration of water-soluble Aniline Blue into potato starch grains and sections of oak wood is similar to that of Congo Red. Thin sections of cork cell walls are coloured by water-soluble dyes (Gentian) in ½ min., deeper in 1 min., but the penetration into cork layers 1 to 2 mm. in thickness is very slow, after the first surface penetration. That a number of liquids with wetting powers for dry surfaces at least as high as that of water cause wetting but no swelling in starch grains, cell walls, &c., is urged as an objection to the micellar theory. Some deductions are drawn regarding the factors determining the diffusion of liquids into colloidal membranes. —B.C.I.R.A.

Cellulose: Estimation. See Section 6.

(D)—Artificial

Viscose: Ripening. R. O. Herzog. *Papier-Fabr.* (Fest-u. Ausland-Heft), 1926, 94-97.

In order to determine the relation between the rates of the separate processes taking place in viscose ripening, formulæ for these were devised. The indication is that the ripening process is probably one of slow coagulation and that the secondary particles are rod-shaped (series of micellæ). —B.C.I.R.A.

Cellulose: Diffusion Experiments with Solutions of, in Copper Ammonia Solution. R. O. Herzog and D. Krüger. *Kolloid-Z.*, 1926, **39**, 250-252.

Diffusion experiments have been conducted with solutions of cellulose in Schweitzer's reagent, varying the concentration of copper, ammonia, and cellulose, and more particularly using cellulose from various sources. The rates of diffusion of cellulose show that the original cellulose crystallites, whose size depends on the nature and history of the material used, are always degraded to particles of the same size in these solutions. Viscosity determinaticns indicate the same dispersion. —L.I.R.A.

Cellulose: Constitution. J. C. Irvine and G. J. Robertson. *J. Chem. Soc.*, 1926, 1488-1501.

By acetolytic degradation of cellulose, deacetylation and subsequent methylation, the authors reached the conclusion that cellulose can be degraded to a mixture of acetates derived from the following compounds in the proportions stated—Dextrins 6%, anhydro-triglucose 35%, tri-glucose 15%, di-glucose 20%. Although the evidence is not conclusive, it appears probable that at least one-third of the cellulose aggregate is based on the tri-glucose unit. —B.C.I.R.A.

Alkali-soluble Cellulose: Preparation. T. Lieser. *Cellulosechem.*, 1926, **7**, 85-88.

In an investigation of β-cellulose, it was found that washed cellulose on treatment at 0° with super-saturated hydrochloric acid is converted as it were quantitatively into alkali-soluble cellulose without a simultaneously occurring rise in the reducing power as measured by the Schwalbe copper number. The nature of the cellulose degradation is not yet known, but it is not a case of hydrolysis. The ability of the cellulose degradation product to dissolve in caustic soda solution (8%) probably depends on the formation of an additive compound with sodium hydroxide. —B.C.I.R.A.

Fine Filament Viscose Silk: Manufacture. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 188-190.

Patents for the manufacture of fine filament viscose silk are surveyed and reference is made to a process of the Spinnfaser-A.G., by which the fine material is produced under the conditions ordinarily used for viscose. The material has a remarkably soft feel and is very pliable. It is much more like real silk than is ordinary viscose. It is particularly applicable to the manufacture of washing silks. —B.C.I.R.A.

Artificial Silk: Identification. P. Krais. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 187-188.

A comparison has been made of Rhodes' method, Götze's method, and the method recommednded by the Cassella Co. in which the material is dyed with Naphthylamine Black 4B in a hot, neutral bath. The tests were made on the following artificial silks—Viscose 7-8 den., viscose 4 den., viscose from linters 7-8 den., cuprammonium silk 12 den., nitro silk, acetate silk. The differences shown by Rhodes' method were more decisive than by Götze's method and the Cassella method was at least equal to Rhodes' and more definite than Götze's method. It is suggested that in Götze's method it would be better not to boil, but only to warm the test mixture. —B.C.I.R.A.

Artificial Silks; Some Characteristic Properties of the——. E. Clayton. *J. Soc. Dyers and Col.*, 1925, **41**, 375-376.

Means for distinguishing between the various varieties of artificial silk are described. —L.I.R.A.

Constitution and Swelling of Cellulose. See Section Ic.

Cellulose Dispersion. See Section Ic.

Cellulose: X-ray Structure. See Section Ic.

α-Cellulose: Estimation. See Section 6.

Patents

Viscose Distributing Motion. E. Robinson. F.P.596,314.

This motion comprises two gear wheels mounted in a frame and gearing one with the other. The viscose is introduced under pressure in the gearing of one of the wheels, carried away with it along a definite course, and lastly directed to the spinning nozzle by the action of the other wheel.

This latter is mounted on a movable support so that the two wheels can be brought nearer. The movable support is under the action of a spring. —Bur. Text.

Spinning of Artificial Silk. O. Leuks and E. Hubert. U.S.P.1,558,375 (from *Text. Colorist*, 1926, 48, No. 565, p. 58).

The apparatus for spinning cellulose acetate fibre is freed from air by boiling and subsequent immersion under water or other precipitating liquid. —F.G.P.

Process of Manufacturing Artificial Silk Threads from Viscose. I. Lams. U.S.P. 1,558,265 (from *Text. Colorist*, 1926, 48, No. 565, p. 58).

The coagulating medium is an aqueous solution of 13-15% ammonium formate and 13-18% sodium formate. The threads are then converted into cellulose hydrate. —F.G.P.

Process of Manufacturing Artificial Silk and Other Products from Nitrocellulose. E. Bindschedler. U.S.P.1,562,076. Lansdowne, Pa.

Nitrocellulose hydrate is dissolved in alcohol and ether and extruded from an orifice. The thread is passed through a coagulating bath of 40-75 parts ethyl alcohol and 25-60 parts glycerine at a speed greater than its exudation. —F.G.P.

Cellulose Ester and Ether Solutions: Preparation. I.G. Farbenindustrie A.G. E.P.245,469. Frankfurt-on-Main.

Di-*n*-butyl phthalate is proposed as a solvent or gelatinising agent for nitrocellulose and other cellulose derivatives. The solution may be used in the production of films, plastics, varnishes, &c. —B.C.I.R.A.

Macarthy Gin Rollers. C. W. Russell, Fort, Bombay, India. E.P.251,674, 251,812, and 251,813.

Ginning rollers for a Macarthy gin are formed from a mixture of coir or like fibre and paper or wood pulp moulded by hydraulic pressure into the form of a roller which can be mounted on a square spindle. The roller, when dry, is trued on a lathe. The mixture may be moulded as a sleeve to be secured to a wooden roller. Alternatively, the rollers are formed by placing strips or fillets of the mixture in longitudinal grooves in a wooden roller; the mixture is compressed between rollers and formed into the strips which are secured in the grooves by cement, &c., or wedges. Thirdly, the rollers are formed by winding spirally on a wooden roller strips of material formed by embedding a woven band of cotton in a mixture of coir fibre and paper pulp. The woven band is covered with the mixture and passed through calender rollers. —B.C.I.R.A.

Artificial Silk Filaments: Spinning. L. A. Levy, London. E.P.251,680.

In a process of semi-dry spinning of artificial filaments, the filaments are extruded into a closed or nearly closed chamber through which is circulated air which may be heated. After leaving the chamber, the solvent remaining in the filaments is removed by passage through a setting-bath which may be heated. —B.C.I.R.A.

Insoluble Cellulose Ethers; Preparation of——. I.G. Farbenindustrie A.-G., Frankfurt-on-Main. E.P252,176.

Alkyl ethers of cellulose which do not swell in water or are soluble therein with difficulty, are prepared from water soluble ethers by mixing with an aqueous solution of the latter a substance which is soluble in the colloidal state in the solution. Suitable substances are water insoluble ethyl-cellulose, bakelite, latex, linseed oil, and benzyl alcohol. The solutions obtained may be used in the manufacture of artificial threads, films, and plastics. —B.C.I.R.A.

Cellulose-xanthic Acid Esters: Preparation. L. Lilienfeld, Vienna. E.P.252,654.

Esters of cellulose-xanthic acids are prepared by acting on a cellulose-xanthic acid or a cellulose xanthate with an ester of an inorganic acid under faintly alkaline or neutral or acid conditions. The parent material may be crude or purified viscose, or even the product of the reaction between carbon disulphide and alkali-cellulose; the purification may consist in precipitation with a salt solution or with alcohol or by carbon dioxide, or in treatment with sulphurous acid or a bisulphite. The reaction occurs without extraneous supply of heat, but it may be initiated or accelerated by heating. The products tend to separate as jellies, except in cases where the reaction mixture is dilute when they appear as fine or coarse precipitates. The products which are suitably washed are soluble in dilute alkali and in many organic solvents such as an aqueous solution of pyridine, and the solutions may be worked up into films, artificial silk filaments, and the like. In examples, a crude viscose diluted with water and rendered faintly alkaline, neutral or acid with acetic acid, is treated with diethyl or dimethyl sulphate, ethyl or methyl iodide, and ethyl bromide. —B.C.I.R.A.

Artificial Silk Spinning Nozzles. C. L. Walker, Aberdeen. E.P.253,209.

Nozzles for use in spinning artificial filaments consist of a capillary tube of noble metal, preferably of platinum or of iridio-platinum, formed by dissolving by chemical or electrochemical means a core of relatively soluble metal. Directions are given for preparing the capillary tubes. The core may have a section other than circular,

when the shape of the core is retained in the finished tube. The cylinder from which the wire is drawn may be provided with a plurality of cores so as to form a multiple nozzle and the wire may be twisted to produce helical passages through which the solution to be spun is extruded. The lengths of capillary tube may be secured by cement in apertures in porcelain or iron nozzle plates. Alternatively, the nozzle may be formed by inserting plugs of noble metal into the apertures in plates of porcelain, molybdenum, &c., the plugs being secured by pressure and finally drilled to form capillary passages. A simple single-jet nozzle is made by sealing a length of capillary tube of noble metal into the end of a glass tube by a method indicated or into a porcelain or metal tube. A nozzle having a plurality of fine passages may be placed in front of the actual spinning nozzle so that solid matter suspended in the spinning solution will be prevented from reaching and choking up the actual spinning nozzle. According to one of the Provisional Specifications the capillary tubes may be formed by heavily plating with platinum, &c., wire of soluble metal which eventually constitutes the core to be dissolved away. —B.C.I.R.A.

Hollow Viscose Filaments. British Enka Artificial Silk Co. Ltd., London. E.P. 253,477.

Hollow artificial textile filaments are prepared by employing a thin fluid viscose and by avoiding the usual precautions for preventing retention of gases in the fibre during the coagulation process, that is, by omitting the degassification of the viscose solution and by employing a bath that coagulates the viscose rapidly. It is preferred to add a small quantity of a zinc salt to the coagulation bath. The thin fluid viscose may be one that contains less than 8% of cellulose or one that is prepared from a strongly bleached cellulose, or from a soda cellulose mercerised in the presence of an oxidising agent, or which has been subjected to an extended ripening process. To the viscose solution may be added pulverised solid material such as pumice powder, which promotes the separation of gas bubbles. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Production of Artificial Fibres

252,033. J. Brandwood and Twyver Works, Ltd. Spring device for spinning box.

252,328. I.G. Farbenindustrie A.-G. Modification of E.P.245,469. (*See above*).

252,344. R. Pictet and F. Tharaldsen. Preparation of wood cellulose.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Bast Fibres: Cottonisation. M. Halama. *Faserforschung*, 1926, **5**, 179-186.

A general discussion dealing with the purpose of cottonisation, chemical disintegration processes, the spinning of cottonised material and raw materials suitable for cottonisation. —B.C.I.R.A.

Flax for Seed and Fibre. M. L. Griffin. *Chem. Abs.*, 1926, **20**, 2069 (from *Pulp Paper Mag. Canada*, 1926, **24**, 299-301).

The author recommends devising simple apparatus for the conversion of the straw into a clean and reasonably uniform tow which can be transported readily. At the pulping plant it would be cut up, shredded, and dusted, then passed continuously through a kiln drier at relatively low temperature to embrittle the woody, pithy, and bark tissues, and thence directly, before the stock could regain its normal water, into a special attrition mill where the brittle woody shive would be refined and dislodged, and thence into another screen, specially designed to separate again all dislodged refuse. At this stage the product will be more or less balled or wadded and should be run over a scutching or carding machine to form it into a crude sliver according to textile processing. If it can be formed into a loose rope by some twisting of several of the sliver strands, the stock is treated as in the textile industry; if not, the treatment becomes a rag stock process for paper. —L.I.R.A.

Opening, Picking, Carding, and Drawing. Southern Textile Association, Carding Division. *Cotton* (U.S.A.), 1926, **90**, 620-628.

Answers to questionnaires on these processes are reported which form a record of mill practice in the Southern States of America. —B.C.I.R.A.

Use of Snia-fil. *Silk J.*, 1926, **2**, No. 21, p. 62.

This form of artificial fibre is carded, combed, and spun in ways said to be identical to those employed for wool. The makers advise twisters to use the following oiling mixture for the sliver going through the comber—Rape oil 30%, arachis oil 50%, petroleum 20%, in the proportion of 1½% of the top. —F.G.P.

Card Clothing: Supply. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 168.

A plea is made for the support of the German machine making industry as against purchase from England and other countries. German-made card clothing is said to be as good, and in some instances better than the English product whilst the cost, when freight and taxes are included in the cost of the imported product, is not greater. The

author recommends that spinners should purchase their cards without card clothing and acquire the clothing from their usual German makers, or stipulate to the card maker the German firm from which the card clothing is to be obtained.
—B.C.I.R.A.

Card Flats: Deflection. E. Baltz. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 180-182.

A mathematical consideration of the deflection of the flats in revolving flat cards has shown that, though hollow flats are about 15% better than solid flats as regards actual deflection, when other factors are taken into account solid flats are preferable. Ingot iron is slightly superior to Duralumin and the latter is further at a disadvantage on account of its price. The deflection of ingot iron flats is about one-half that of cast-iron flats where the flats have the normal ⊥-shaped profile.
—B.C.I.R.A.

Sliver Combing Device. F. Kirschleger. *Rev. Text.*, 1925, **23**, 1003.

A small bronze ring, screw-threaded on the inside, has eight steel needles set obliquely into it, their free ends converging and approaching each other more or less nearly according to the quality of the cotton, the number of the passage through the device and the roving number, e.g., they may be spaced 3 mm. apart at the first passage through the card and 1 mm. only at the last passage through the drawing frames. The device is equally easily fixed to the sliver trumpet or the coiler head of the sliver can. It is still more easily fixed to the drawing frame, the points being brought as closely as possible to the drawing rollers without touching them. The device exerts a combing and straightening action on the fibres. Sliver which has passed through it is said to be rounder, more uniform, silkier, better condensed, free from fly and, due to compression, occupies only one-half the volume of the untreated sliver so that a sliver can contains about 30% more cotton. The strength of the finished yarn is said to be increased by more than 10% and its coefficient of regularity may be increased by as much as one-half.
—B.C.I.R.A.

Unshrinkable Processes for Wool. E. R. Trotman. *Text. Mfr.*, 1926, **52**, 310.

Wool immersed in an aqueous of chlorine is capable of absorbing 30% of its weight of the gas, the wool being thereby changed to a yellow translucent gelatinous substance while hydrochloric acid is simultaneously formed. Unshrinkable wool produced by mild chlorination will wear satisfactorily, provided that not more then 20% of the fibres have been damaged (during chlorination) by removal of the epithelial scales. After chlorination wool is the more likely to be damaged by bleaching with hydrogen peroxide. —A.J.H.

Carding Engine: Control. R. Belshaw. *Text. Rec.*, 1926, **44**, No. 518, pp. 77-80.

The mechanism of the carding engine and its control is discussed from the author's own experience. —B.C.I.R.A.

Combs: Modern Flax and their Setting. C. R. Carter. *Text. Rec.*, 1926, **44**, No. 519, pp. 54-55.

New models of flax combing machines are described and detailed instructions for starting and setting given. The Gruen Comb 1924 Model is stated to have a higher working speed than older models, its output varying from 15½ lb. to 26½ lb. per hour. The P.A.E. Tow Combing Machine made by N. Schlumberger & Co., deals with flax tow up to 13¾ in. long. The production varies from 13 lb. to 17½ lb. per hour.
—L.I.R.A.

Flax Retting: New Methods and their Influence of the Wool Industries. *Text. Rec.*, 1926, **44**, No. 521, p. 53.

A new process for decorticating flax, ramie, and similar fibres within 2 hours is reported (but not described) which it is claimed will put these fibres in competition with artificial silk and cotton. It is predicted that the effect of this process, whereby linen fibres will be cheapened, will be felt less by the woollen than by the cotton industry. —A.J.H.

Blending Wools for Top-making. *Text. Rec.*, 1926, **44**, No. 522, p. 51.

A discussion on blending wool for "tops."
—A.J.H.

Merino Wool Classing. P. D. Rose. *Text. Rec.*, 1926, **44**, No. 522, pp. 52-53.

A description of methods for grading South African merino wools. —A.J.H.

Removal of Incrustations from Flax Fibre. See Section 6.

(B)—Spinning and Doubling

Textile Machinery Mechanisms. W. A. Hanton. *Engineering*, 1926, **121**, 642-644 and 707-709.

In an article dealing with some mechanisms of textile machinery the writer describes spinning frame motions, mule carriage motions, the Souczek shuttle mechanism, and the four-colour automatic weft changing motions of the Northrop and Ruti looms. —B.C.I.R.A.

Twist Yarns in Rayon Weaving. "Tindairns." *Silk J.*, 1926, **2**, No. 21, p. 44.

Twist yarns are used for ornamenting fabrics either of all rayon or mixtures of rayon with wool and worsted. A very full description of a machine suitable for the purpose is given, and it is stated that experimental work has been done upon it.
—F.G.P.

Cotton Yarns: Twist. *Textielind.*, 1923, **4**, 365-370.

The question of the amount of twist required in warp and weft yarns is discussed

in relation to staple length and a table is given showing twists used for cotton warps and wefts of different classes and counts. The way in which lustre or shadow effects in woven fabrics may be obtained by combining warp and weft yarns differing from one another in their direction of twist is described. —B.C.I.R.A.

High Draft Mechanism: Installation. "P.L." *Rev. Text.*, 1925, **23**, 1133.

Some general advice on the installation of high draft mechanism is given. For short staple cotton a system having a running leather band is preferred and for long cottons a system having a light roller pressure at the second line of rollers.

—B.C.I.R.A.

Folded Yarns: Counts Calculations. *Text. Rec.*, 1926, **44**, No. 518, pp. 52-53.

Some examples of counts calculations for folded yarns are considered. —B.C.I.R.A.

(C)—Subsequent Processes

Quick Traverse Cheese Winder. Langenthal Machine Works, Ltd. *Text. Rec.*, 1926, **44**, No. 518, p. 93.

The machine described was designed to obviate the defects of split drum winders. It consists mainly of a drum on both extremities and along the entire circumference of which runs a groove which is a few millimetres deep. On the inner edges corners are milled the height of which corresponds to the cut-away part. On the traverse rod of the thread guide, which is operated by a heart-shaped cam, is a thread guide which catches the yarn automatically so that no threading is necessary. As the thread guide is not responsible for the order of the yarn on the cheese, the point of the cam is rounded off. This arrangement does away with the jerky motion of the thread guide and its to and fro motion is a gentle one. As the drum revolves, the thread guide travels to and fro in front of it and the yarn is laid in a loose form on the drum. It is then caught by the corners on the drum and put into the position in which the cheese receives it from the drum. The machine can easily be adapted to serve as a yarn-gassing machine. —B.C.I.R.A.

Stretch in Rayon Yarns: Winding Precautions. *Silk J.*, 1926, **2**, No. 20, p. 63.

The effect of moisture on rayon is to cause it to stretch more readily and the elongation is to a great extent permanent, therefore every effort must be made to keep the humidity constant during winding and weaving for unequally stretched rayon will cause many defects in the finished cloth, including uneven dyeing. —F.G.P.

(D)—Yarns and Cords

Novelty Yarns. *Text. Rec.*, 1926, **44**, No. 518, pp. 47-48.

Brief notes are made on the appearance and method of production of the following fancy yarns—Coloured twists, marl yarns, spirals, corkscrews and ondes, gimp yarns, loop yarns, three-colour spiral yarns, knop yarns, alternate knops, flake knops, spot knops, cloud yarns, slub or variable spun yarn, intermittent chain yarn.

—B.C.I.R.A.

Patents

Spinning Frame Stop Motion. E. Giro-Prat, Barcelona, Spain. E.P.251,789.

A spring thread guide is fixed to an eccentric flexibly connected to a lever, arms on which are arranged to lift the spool from the driving drum when the thread tension is excessive. —B.C.I.R.A.

Yarn Clearing Device. Eclipse Textile Devices Inc., Elmira, N.Y., U.S.A. E.P.251,799.

In any device for performing on a travelling yarn any operation necessary to prepare it for use in weaving, knitting or sewing, the position of the operative element is automatically adjusted in accordance with the thickness of the yarn by a controlling member gently urged against the thickness of the yarn. The mechanism is described in connection with a slub-catching device for winding machines. —B.C.I.R.A.

Opening Machine Feed Device. J. J. Marx Kommandit Ges., Pfalz, Germany. E.P. 251,936.

In an arrangement for feeding large quantities of fibrous materials to openers, carding machines, &c., the material is drawn from a hopper by a double conveyer device comprising a series of toothed parallel members alternating with a series of plain supporting members. The teeth project beyond the supporting surface on the upward slope and are withdrawn gradually on the horizontal portion, so that the material has a free drop, at the delivery point, from the conveyer to the feed apron of the opener, &c. The rate of the feed is regulated by adjusting the speed of the conveyers.

—B.C.I.R.A.

Cap-Frame Spindle Apparatus. L. A. Levy, Cricklewood, London. E.P.252,471.

A slotted cap for use in spinning artificial silk in cap frames is provided with a conical base, and an opposed cone beneath is arranged coaxially therewith so that a space of about an eighth of an inch is left for the passage of the filaments which contact only with the lower edge of the cap. Slots are provided in the lower cone to permit the passage of the driving belt as the bobbin is raised and lowered.

—B.C.I.R.A.

Card Cylinder Reversing Gear. R. Benson, Oldham. E.P.252,503.

A reversing gear for the main cylinder of a carding engine to enable it to be driven for grinding is described. —B.C.I.R.A.

Roller Drafting Heads. S. Whitley & Co. and W. B. Walton, Halifax. E.P.252,857.

Self-weighted top rollers for ring spinning and other machines are connected together by a non-rigid coupling such as a cord, wire, chain, cable, links, &c., or are similarly connected to a weighted central boss carried in a saddle and neb arranged so that no weight is transmitted to the rollers. When the front top roller comprises loose bosses on stationary spindles, the saddle may be attached to the spindle by soldering or by setscrews. The rollers are held in place by a spring so that the saddles may be turned over to facilitate the cleaning of the rollers. —B.C.I.R.A.

Spinning Machine Cleaning Apparatus. Firth-Smith Co., Boston, U.S.A. E.P. 253,121.

A blower is traversed along a track over spinning or like machines so as to direct a stream of air on to each machine successively and to force loose fibres, lint, and dirt towards the floor, the pressure of the air being sufficient to prevent their cohesion and accumulation. An electromotor mounted on a spider and fed by means of trolleys from conductors, drives a fan in a casing, and a sheave which engages the track. The orifice of the casing is substantially the same width as the machines and in order that it may clear obstructions such as driving belts, suitable guides are provided which engage a stud or roller on the upper rim of the casing and turn it through the required angle, springs, secured to the casing and to the spider, serving to return the casing to its normal position which is determined by spring-operated ratchet rollers. —B.C.I.R.A.

Spinning Spindle: Oil-retaining Device. T. A., H. A., J., and J. & T. Boyd, Ltd., Glasgow. E.P.253,352.

In spinning, twisting, and like frames in which the spindles are wholly or partly inverted for the purpose of doffing, the space between the internal bearing tube and the socket is of such capacity as to receive all the oil from the socket when the carrier is rotated to invert the spindle, and an inverted cup is mounted on the spindle to receive any oil that may flow down the spindle. A spring catch is provided to keep the spindle in position when it is inverted. An oil cup is screwed on the end of the socket and lubricating holes are formed in the tube above the footstep. The cup may be used on spindles not provided with the described space between the spindle socket and the tube. The flyer legs engage and drive the spindle by a cross member on the spindle. —B.C.I.R A.

Artificial Silk Mixture Yarns. J. A. Grand, Villeurbaune, Rhone. E.P.253,547.

Threads are produced by the use of artificial silk cut to suitable length and mixed prior to spinning with hemp, flax, jute, nettle, or like vegetable fibres, which have been previously freed from gum and rendered silky in appearance by mercerising. —B.C.I.R.A.

Winding Machines: Driving Mechanism. G. Kershaw, Rochdale. E.P.253,563.

In machines for winding yarn or thread from a beam, warp, &c., on to a spindle, tube, &c., the delivery rollers are driven through a ratchet and pawl or other mechanism so that they may overrun if the rate at which yarn is being wound increases. To obviate too rapid delivery of yarn when the mechanism is started, the drive is transmitted through a spring coupling or through a friction clutch in which a sprocket drives the rollers through a disc held frictionally against the sprocket by a spring. When the tension rollers are overrunning a disc of flannel, &c., carried by a disc on the driven shaft provides frictional resistance and so acts as a brake. —B.C.I.R.A.

Spinning Machine Knee Brake. A. Lees and Co. Ltd., and J. W. Clegg, Oldham. E.P.253,842.

A knee brake for spinning and like machines comprises a head to which arms for attaching the brake to the machine are secured, and having a wide, shallow grove in which a braking strip of leather or like material is detachably held by a bolt. The base of the groove projects towards the arms, whereby a large area of the head is in contact with the leather. The arms may be of riveted steel rod. —B.C.I.R.A.

Artificial Silk Strengthening. L. Lilienfeld, Vienna. E.P.253,853 and 253,854.

The strength of artificial textile materials such as viscose, cuprammonium, and denitrated nitro-silks is improved by treatment with a solution of caustic alkali of not more than 5% and preferably of less than 1% concentration, it being necessary that the material should be maintained in a stretched condition during at least a part of the process. Strength may similarly be improved by treatment with a solution of a cellulose thiourethane in which at least one hydrogen atom of the amino group is replaced by an alcohol radical. The material may be treated in the form of threads, skeins, cops, &c., or as woven materials consisting of artificial textile material alone or mixed with cotton, wool, silk, &c. The solutions may be applied by passing the material through, by spraying, by contact with moistened rollers, or by other methods. The alkali-treated material may be finally steamed or heated. The material treated with cellulose thiourethane solution may be passed through one or more pairs of rollers, or otherwise pressed to distribute the solution uniformly. The impregnated material is afterwards treated with a precipitating agent or is dried, preferably at a raised temperature, the method selected depending on the character of the solvent

employed in making the original solution. Alternatively, a combination of these methods may be employed. The material may be stretched during the impregnation process or afterwards, for instance, during the drying at a raised temperature. To render the treated material highly flexible it may be treated with the vapours of a solvent for the thiourethane or of an agent that imparts plasticity such as the vapours of aqueous pyridine. —B.C.I.R.A.

Spinning Frame Roller Head. E. Kübler, Neunkirchen - on - Sudbahn, Lower Austria. E.P.253,901.

In drawing apparatus for spinning machines of the kind in which the middle lower roller is provided with two pressing rollers, these rollers are arranged so that the lines joining their centres to the centre of the middle lower roller make equal angles with the vertical and so that the tangents at the nips of the front rollers and of the front pressing roller coincide or practically coincide. The back pressing roller is of the same size as the middle roller of an ordinary frame and is comparatively heavy and may be additionally weighted. The arrangement ensures a delimitation of the draft between the back and middle rollers, and between the middle and front rollers. The back pressure roller is vertically above the back roller. The front pressing roller is mounted between cheeks of a sheet-iron claw adjustably secured by a screw. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Preparatory Processes

251,885. A. Lees & Co. and J. W. Clegg. Cap bar for slubbing, intermediate, and roving frames.

253,722. E. Barton. Silk-dressing machine.

253,827. W. Layland. Automatic raising device for feed knife of Noble comb.

253,912. Soc. Alsacienne de Constructions Mecaniques. Gill-bar device.

Spinning

252,423. A. & J. Stell and H. Welch. Bobbin support for flyer frame.

252,877, 252,878. R. L. Sutcliffe. Devices for enclosing central-core yarn with outer binding thread, &c.

253,383. T. Gibson. Automatic spindle braking device.

253,422. H. W. Knoll. Fastening for spindle bands.

253,793. J. H. Rothery. Cap spindle bearing device.

Subsequent Processes

252,596. H. Meynell. Clearer or Slub-catching device.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Warping Machine Wave Motion. *Text. Rec.*, 1926, **44**, No. 518, 91.

A patent wave motion for attachment to horizontal warping machines for warping worsted and cotton in the manufacture of fancy worsteds containing cotton stripes is described. The device overcomes difficulties due to the elastic nature of the worsted and the inelastic nature of the cotton. The striping ends are under positive control and are delivered on to the swift of the warping mill in such a manner as to ensure constant and calculated over-length which, by adjusting the contrivance, can be repeated or altered as desired. —B.C.I.R.A.

(B)—Sizing

Sized Warp: Extension in Sizing. W. J. R. *Cotton* (U.S.A.), 1926, **90**, 682.

In experiments to determine the amount of stretch occurring in the slasher, a wheel counter was mounted on the back of the slasher to measure the incoming yarn and the number of yards delivered was determined by the cut marks. From the direct gain in length it would appear that the yarn was stretched a little over 2%, but the length of yarn unwound at the slasher was less than the length when it left the warpers and the length delivered from the front of the slasher was about the same as that delivered at the warpers so that, actually the yarn contracts at the slasher and is then stretched back to its original length. —B.C.I.R.A.

Maize Starch Derivatives: Application. W. R. Cathcart. *Amer. Dyestuff Rep.* (Proc. Amer. Assoc. Text. Chemists and Colourists), 1923, **12**, 21-24.

An outline is given of the process of manufacture and textile uses of maize starch, modified maize starches, dextrins, gums, maize syrup, and maize sugar. —B.C.I.R.A.

The Sizing of Rayon. *Silk J.*, 1926, **2**, No. 20, p. 43.

Rayon warp yarn having, usually, only a small twist, the filaments are easily separated and damaged by friction through the healds. Greater twist has been tried without much success. Waxing is frequently adopted and gives satisfactory results. When the yarn is being wound it may be wetted with a solution of paraffin wax or passed between two wax discs. In hand weaving of silk it was customary to spray the warp with a weak glue solution and dry it by waving a paper fan. Bobbin to bobbin sizing has replaced warp-sizing for rayon. The yarn is wound from its original bobbins over a sizing roller on to metal bobbins with a hollow perforated

barrel to allow of drying. A sizing mixture is $3\frac{1}{2}$ lb. flexible starch, $1\frac{1}{2}$ lb. corn starch mixed with 3 gals. water, poured into 15 gals. water, boiled with stirring for 20 mins. and cooled to 90° F., which is maintained during work (3% of glycerine renders starch flexible). For hard spun yarns—11 gals. water, 5 lb. gelatine, 3 oz. glycerine, boiled for 20 mins. For hank sizing—30 lb. gelatine boiled for 20 mins. in 66 gals. water. Steep the hanks, when tepid, for 15-20 mins. and whizz. After shaking out they are hung in the stove where the hot air is admitted at the bottom. —F.G.P.

Size: Temperature and Weaving Efficiency. P. Bouju. *Rev. Text.*, 1925, **23**, 1051-1057 (from *Bull. Soc. Ind. Rouen*).

Three warps were identically prepared from the same lot of yarn and sized on the same machine with the same size but at three different temperatures. The warps were woven on adjacent looms under identical conditions and the number of breakages and the cause of each breakage was ascertained. In the first test the warps were sized at 77, 91, and 97° C., and in a second test at 79°, 98°, and 100°. A definite relation was found between sizing temperature and the number of breakages in weaving. Within the experimental limits (75-100°) the number of breakages was less as the temperature was lower. The influence of temperature was greater the finer and closer the warp and with dense warps the number of breakages increased very rapidly as the boiling point was approached, passing from 2·181 breaks per yd. at 98° to 3·000 breaks per yd. at 100°. With coarse and open warps the number of breaks did not increase much above 90° and the temperature must be about 75° to obtain any notable improvement in weaving output. In the first set of experiments sizing at 77° instead of 97° reduced the number of breakages by about one-quarter, corresponding to an increased weaving output of 2·5%. In the second set, the number of breaks at 79° was slightly more than half the number at 100°, corresponding to an increased loom output of 5%. The results are explained theoretically. —B.C.I.R.A.

Gum Tragasol: Application. R. Lebailly. *Rev. Text.*, 1924, **22**, 47-51.

An article describing the use of Gum Tragasol (Star gum) as a sizing agent. The sizing properties are discussed in detail and a description is given of the chemical properties of the gum, the method of preparing the sizing solution and its applications. It is claimed that Gum Tragasol is superior in sizing properties to other adhesives; that, being more concentrated, it is as cheap; that it allows of rapid drying; that greater strength is conferred on the threads by gum tragacanth size than by other sizes and that penetration is much more regular. Advantages are claimed for gum tragacanth, in hank sizing particularly, in the direction of obtaining regular unwinding. Results of tests carried out in the sizing machine indicate the advantages obtainable on account of the greater penetrative power of gum tragacanth as compared with other sizes. —B.C.I.R.A.

Gum Tragacanth. G. E. Van Tromp, Govier. *J. Soc. Dyers and Col.*, 1925, **41**, 370-371.

The author describes the origin, method of collection, varieties, and characteristics of gum tragacanth. Analytical results obtained with four samples of the gum are given. —L.I.R.A.

Rayon Slasher Machine. *Text. Colorist.*, 1926, **48**, 554-555.

A machine suitable for sizing artificial silk warps without stretching or chafing the yarn is described. —A.J.H.

Starch Paste: Mechanical Liquefaction. See Section 6.

Starch: Constitution. See Section 6.

(C)—Weaving

New Shuttle Material. *Amer. Silk J.*, 1926, **45**, No. 1, p. 58.

A Dutch product called "Lignostone" is made of specially treated compressed wood. It is of such hardness and durability that there is no danger of chipping or splintering and is considered to be an ideal material for shuttles. —F.G.P.

Twilled Fabrics: Weaving. J. Funke. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 57.

A method is described of weaving on a jacquard twills having high weft repeat numbers, but in which the number of cards employed is limited. For example, if two weaves with weft repeats of 9 and 11 dovetailed weft-wise are woven, the design will have a weft repeat of $9 \times 11 \times 2 = 198$. In the following way the number of cards is limited to the sum of the two weft end numbers employed, viz., $9 + 11 = 20$. The two selected designs being chosen, the cards are separately cut and linked, but after each card a completely perforated one is inserted. The two card chains are laid on one another on the cylinder with the result that a pattern card is always superimposed on a fully perforated one. Since the latter will not interfere with the action of the former the desired design is obtained. By reversing the card chain or chains it is possible to produce eight different weaves with weft repeat of 198, thus replacing 1,584 cards. Point paper diagrams are given for a number of weaves obtained by card chain reversal, employing in each case 7-end and 16-end stitched twill weaves. —B.C.I.R.A.

Fast Reed Loom: Change of Speed. P. Beckers. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 154-155.

Adjustments in fast reed motions, particularly in the inclination of the stop rod nib, when the speed of the loom is increased are discussed. —B.C.I.R.A.

Shuttle Checking Motion. Grossenhainer Webstuhl und Maschinenfabrik A.G. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 155-156.

An improved double-acting shuttle-checking motion for change box looms is described. It has two checking straps connected by a double lever. One strap is attached to the slay through a tension lever and roller and the other strap is attached to the setting pin by a revolvable link. —B.C.I.R.A

Terry Towelling Loom. *Rev. Text.*, 1924, **22**, 53-61.

A loom designed by the Ateliers Diedrichs for weaving terry towellings is described. There is an independent heald driving mechanism, fringe-drawing is automatic without stoppage of the loom, picking with four colours is possible by the employment of drop box motions, and the loom can function without vibration at speeds comparatively much higher than those employed previously. The firm's known improvements in slay design, shuttle mechanism, card reduction, &c., are embodied in the new terry loom, and the mechanisms characteristic of the loom, which are described in detail, are the reed motion, the device for loop elimination in the coloured weft stripes and in the weft threads which are put in at intervals to reinforce the fabric, the automatic fringe-drawing mechanism and the stopping of picking and weft fork motion at the moment of fringe-drawing. —B.C.I.R.A.

False Selvage Bobbin Creel. *Rev. Text.*, 1924, **22**, 67.

The article describes a device invented 25 years ago by Prof. Bon for feeding yarn in weaving the centre selvage in a double selvage cloth. The yarn is run off bobbins on free spindles carried in two pairs on two rotating discs, the thread passing outwards through holes in the discs. The discs carry a device for rewinding the spindles should any slackening of the threads occur. —B.C.I.R.A.

Warp Streaks in Silks. J. Chittick. *Text. Amer.*, 1926, **45**, No. 2, p. 47.

When business is good, it is said, there is little complaint about these faults, but when it is bad, goods are rejected on the flimsiest pretexts and often by buyers who have no knowledge of how much freedom from streaks they may rightly expect. The higher the quality of the silk the less the risk of streakiness, but there is considerable variation in the size of threads even in good qualities. Streaks are more visible in satin weaves than in plain with the same silk because the warp only appears on the face. Raw silk warps show them more than organzine, though irregular twisting and doubling will bring them out. Imperfect reeds will cause streaks and all running looms should be carefully watched for injuries produced by a carelessly handled reed-hook or bad cleaning. Section marks in the warp must be avoided; they may be caused by bent pins on the creel or worn bobbins, or by the threads mounting in a long warp and causing irregular tension. Mixing of silk into a warp in order to use up odd lots will produce streaks unless the utmost care is exercised. Irregular dyeing will also cause them. —F.G.P.

Weaving Artificial Silk. J. J. Sussmuth. *Text. Mfr.*, 1926, **52**, 316.

Practical details of weaving are discussed. —A.J.H.

Souczeck Shuttle Mechanism; Northrop and Ruti Weft-changing Motions. See "Textile Machinery Mechanisms" in Section 2B.

Twist Pattern Fabrics. See "Cotton Yarns: Twist" in Section 2B.

(D)—Knitting

Knitting Oil-treated Rayon. W. Whittam. *Silk J.*, 1926, **2**, No. 20, p. 57.

To assist the easy passage of rayon in the knitting industry it has been found necessary to dress the yarn with an oil that will not evaporate during work to any appreciable extent. A neatsfoot oil solution is employed and the quantity left on the fibre ranges from 6·16% to 7·46%. After ten days' exposure to air the loss was not more than 0·5%. —F.G.P.

Full-fashioned Gloves: Knitting. W. Davis. *Text. Rec.*, 1926, **44**, No. 518, 69.

The production of full-fashioned gloves on the hand frame or Cotton's patent frame is discussed. A full range of gauges and numerous attachments to give varied effects can be used with these frames whilst the glove made on the flat knitting machine is of the coarsest gauges only, the machine seldom exceeding seven needles per inch. —B.C.I.R.A.

"Super-auto-striper" Flat Knitting Machine: Patterning Mechanism. J. B. Lancashire. *Text. Rec.*, 1926, **44**, No. 518, 71.

A description is given of the "Super-auto-striper" patterning mechanism for flat knitting machines which has been designed to supersede the "Auto-striper." The device effects the individual control of the needles of one bed, the extra mechanism being readily fitted to existing machines of the simple type. —B.C.I.R.A.

(E)—Lacemaking and Embroidering

Imitation Embroidery. See Section 4J.

(F)—Subsequent Processes

Cloth-plaiting Machine. *Text. Mfr.*, 1926, **52**, 269-270.

The machine, which is of the usual convex-table type, is provided with an automatic compensating lag device which ensures that all folds of the fabric are plaited to the same length. —A.J.H.

History of the Prevention of Moth Damage to Textiles. A. P. Sachs. *Text. Colorist*, 1926, **48**, 526-530.

The description of the life history of moths, larvæ, and eggs commenced in the previous article, is now concluded and a summary of patented methods for protecting fabrics from damage by moths is given. The value of printer's ink as a protection against moth is doubted since ordinary newspaper (without printing) is as effective as printed newspaper. Many of the preventatives which have been used and suggested are active but are volatile, e.g., *p*-dichlorobenzene and naphthalene. Under suitable conditions four generations of moths may be successively produced in one year, that is 235,000 moths may be ultimately developed from one moth, these being capable of consuming 21·5 to 46·5 Kg. of wool. —A.J.H.

(G)—Fabrics

Jungle Modes in America. *Amer. Silk J.*, 1926, **45**, No. 1, p. 38.

Plush fabrics in imitation of leopard, tiger, and lion skins are being made in Germany and exported to the African natives for use as loin cloths, and it is suggested that American manufacturers might also manufacture these cloths profitably. —F.G.P.

Crêpe Meteors. J. Chittick. *Silk J.*, 1926, **2**, No. 20, p. 45.

This important crêpe fabric was brought out a few years ago by the great French designer, Bianchini; in appearance it has a smooth face with a good but subdued lustre and on close inspection shows a fine twill. The back is even less noticeably twilled. It has a beautiful feel, silky, pliable, and firm, with no sponginess. It is piece dyed and the weave is the simple three-harness twill, two up and one down. The warp is generally 20/22 den. raw silk of very high class. The weft should be as firm as possible with a minimum of crêping. It is usually 3- or 4-thread white raw silk of 13/15 den. with 40-50 turns per inch. A good Japan extra or best extra should be used. Half is thrown right and half left in alternate two picks. After weaving, very careful picking is necessary. Uniformity in tension during manufacture is essential. Printed meteors are very popular in America. —F.G.P.

Rayon and Worsted Dress Fabrics. *Silk J.*, 1926, **2**, No. 20, p. 49.

Details are given of a number of union fabrics which are finding a big market on the Continent and it is thought that English manufacturers are losing great opportunities for business in not putting out similar materials. Whipcords and gabardines in this mixture are said to be extremely popular. —F.G.P.

Synthetic Suits and Underwear. *Silk J.*, 1926, **2**, No. 20, p. 52.

Sniafil, the new artificial wool fibre, is of the same constituents as, but undergoes different treatment from viscose, being produced as a staple, in short lengths like wool and has no appreciable lustre. The advantage of having constant supplies of this sort of "wool" without the anxiety of keeping sheep is commented upon, and the added advantage of saving the heavy transport charges on wool is worthy of notice. It is said to be indistinguishable in handle and feel from wool and its hygienic properties to be the same, while its wearing and laundering qualities are equal to the natural fibre. Sniafil is to be made in England. —F.G.P.

Rayon Tops the Salvation of the Wool Trade. *Silk J.*, 1926, **2**, No. 21, p. 56.

Rayon is being welcomed in the wool trade, it is said, although its use by the operatives has been in the nature of a revolution. Rayon in the form of tops capable of being drawn, spun, and twisted with wool is an increasing industry. In spite of the many advantages of piece-dyed goods, it is stated that they are on the wane and that botany mixtures are coming into their own. Wool-cotton mixtures are liable to wear threadbare, but wool-rayons are not so disappointing and are of greater beauty. The simplest, plain hopsack and twill weaves are expected to offer ample scope for colour and weaves, without requiring expensive drafted or dobby designs. —F.G.P.

Fabrics of the Future. *Silk J.*, 1926, **2**, No. 21, p. 63.

It is said that rayon is now employed in 1,000 different fabrics. Novelty and low cost are to be the prime considerations. The production of textiles is stated to be below the world's requirements and artificial fibres are needed to fill the demand. Rayon gives colour and brightness, but as strength is an essential it must be mixed with natural fibres. —F.G.P.

New Artificial Silk Lining Industry. *Text. Argus*, 1926, No. 103, Sept. 1st, p. 4.

Viscose and cellulose acetate silks have become important fibres in the manufacture of lining fabrics since they allow the production of cheap, light but lustrous fabric suitable for use with ready-made garments. Artificial silks now enter largely into construction of Irene, Albert, Hilda,

and Beatrice twills and the hitherto essential mohairs and alpacas have been replaced. —A.J.H.

Serviettes, Table Cloths, and Damasks: Weaving. *Textielind.*, 1924, **5**, 200-210.

Point paper diagrams are given for serviette, table cloth, and damask fabrics, &c., in which lustre effects are obtained by the use of satin weaves. For example, a 5-shaft satin weave in which a warp thread passes over four and under one weft thread, viewed on the right side of the material (or alternatively a weft thread passes over four and under one warp thread) gives a smooth, glossy surface and is a common weave for serviettes, &c. It is shown that lustre increases with shaft number but the maximum practicable number for the fabrics under consideration is 10 shafts. Increased lustre and shadow effects can be introduced by using combinations of warp and weft yarns of opposite twist. It is further shown how 15-shaft damasks and other fabrics can be built up by using various combinations of the fundamental 5-shaft patterns. —B.C.I.R.A.

Bed Spreads and Table Cloths: Weaving. *Textielind.*, 1924, **5**, 681-688 and 773-779; and 1925, **6**, 481-490 and 715-718.

Point paper diagrams and weaving directions are given for numerous highly patterned bed covers, table cloths, decorative fabrics, &c. The fabrics are divided into three classes : those with single warp and double weft systems, those with double warp and single weft systems and those with double warp and double weft systems. Many-coloured effects are introduced. —B.C.I.R.A.

Tapestry Weaving. —. Gräbner. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 169-171.

Point paper diagrams and weaving directions are given for a weft tapestry patterned on both sides. —B.C.I.R.A.

Cotton Duck: Specification. C. W. Schoffstall and R. T. Fisher. *Technologic Papers, Bur. Standards*, 1926, **18**, No. 264, 443-464.

The test methods used in a study of various samples of numbered duck of medium and hard textures are shown. For breaking strength, the strip and three types of grab methods were used. The $1 \times 1 \times 3$ inch grab method was selected for the standard breaking strength method of test. The results are tabulated and the significance of the data is illustrated in various graphs. The study of the results shows how the specifications were formulated. The final specification for numbered cotton duck is given. —B.C.I.R.A.

British Styles in Men's and Women's Wear. *Text. Amer.*, 1926, **45**, No. 1, p. 13.

In worsteds, cheviots, and saxony materials rayon is being introduced for stripes in black and dark shades. It must be of the best quality, otherwise the stripe will give way before the material has worn out. A two-ply two-fold thread is preferable to a two-fold yarn. —F.G.P.

The Vogue of Novelty Curtains. *Text. Amer.*, 1926, **45**, No. 1, p. 14.

French and Swiss curtains are said to have passed out in America, being replaced by native fabrics. Really artistic ruffled curtains are made in scrims, voiles, and marquisettes, in solid colours, in two-tone effects and in six to eight colour combinations. The introduction of rayon has enhanced the beauty of these cloths and has made the more severe lace curtain still less popular. —F.G.P.

Manufacture of Madras Handkerchiefs and Lungees. D. M. Amalsad. *Text. Mfr.*, 1926, **52**, 280 (from *Indian Text. J.*).

Madras handkerchiefs, a class of goods made in India from imported yarns, are made from grey and coloured warp and weft yarns, the coloured yarns being allowed to bleed during weaving and thereby tint the grey yarns. Lungees, Kailies, and Kambayans are trade names for tartans made from coloured warp and weft yarns, and are very popular among Mohammedanmen for dhooties and headwear and among Hindu women as dress materials. Particulars of weaving and of the quality of these fabrics are given. —A.J.H.

New Use for Linen. C. R. Carter. *Text. Mfr.*, 1926, **52**, 297-298.

Artificial leather prepared by several impregnations of cotton fabric with cellulose solutions and afterwards embossed (the Ford Motor Company uses 20 million yards per annum of such fabric, 54 in. wide, for motor upholstery) may be advantageously replaced by a rubberised fabric. The fabric to be used for the rubber product must not contain more than 20 warp and 16 weft threads; the strength of such a cotton fabric is too low, but linen fabric is satisfactory in all respects. —A.J.H.

Cotton-Artificial Silk Union Fabrics. Wilsons Fabrics, Ltd. *Text. Merc.*, 1926, **74**, 532.

Three novelty fabrics are described—(1) A voile of cotton and Celanese with the Celanese thrown well to the top and the pale blue ground over-printed in a fancy stripe design in navy blue and gold, (2) a bordered marocain of cotton and artificial silk in which the embroidery is woven and the fabric is cross dyed, and (3) a cotton voile with wide artificial silk border in a light pattern of viscose and Celanese, in which cross dyeing is again employed. —B.C.I.R.A.

Twilled Fabrics. See Section 3C.

Patents

Weft Feeding: Continuous Motion. Mullor et Carriol. F.P.595,585.

This device comprises a special shuttle in the centre of which an axle bears a double balancing lever. One lever comes into contact with the loom buffer when the shuttle is at end of its course, the other bears yarn catching forks which under pressure release the shuttle for the next course. The shuttle catches the weft and conducts it in double loop into the shed and leaves it on the hook on the other side of the list. This hook brings the end of the double yarn exactly to the place where the previous loop was left. The motion is repeated for the next shed but with the yarn from the other bobbin.
—Bur. Text.

Improvements to Circular Knitting Machine. M. de Horrevitz. F.P.596,018.

These improvements, to a machine for stockings, permit the neutralisation of the levers distributing yarn at any given moment. For this purpose, at the end of these levers is transversally disposed a shaft which oscillates and on which are disposed fingers. The oscillation of this shaft is procured by other fingers disposed on a drum which is moved by a rod. The rod comes into contact with eccentrics disposed on the main shaft of the machine.
—Bur. Text.

System of Box Changing. Société Bruyere et Banzet. F.P.596,145.

The connecting rods of the oscillating lever commanding the driving rod of the box-change are hinged to noses fixed upon discs joined to toothed and freely rotating sleeves disposed in parallel. Between these sleeves, frames are disposed vertically and alternately, bearing racks which can be engaged with the discs on their ascending course. —Bur. Text.

Knitted Fabric. M. Wansker, Manchester. E.P.251,710.

A fabric consisting of artificial silk or rabbit wool and cotton is made on a flat machine in cardigan, half cardigan, or racked stitch, by plating, whereby one of the materials appears mainly on the two faces, whilst the other remains in the centre of the fabric. The plater is formed with a central passage for the plating yarn and a semi-circular guide for the backing yarn.
—B.C.I.R.A.

Knitting Machine: Streaked Patterning Mechanism. Dresdner Strickmaschinen-Fabrik Irmscher & Witte A.-G. and M. Kühne, Dresden, Germany. E.P. 251,816.

The invention of Specification 250,796 is modified in that grooved needle beds are dispensed with, the needles being guided on and under bars. The butts are situated below the needle stems and are operated on by toothed wheels on a carriage traversed by an endless chain. The carriage is provided with rollers running on bars.
—B.C.I.R.A.

Circular Knitting Machine: Plating Mechanism. T. G. Whyte and T. Smith, Shepshed, Leicestershire. E.P.251,864.

Reverse plating effects are obtained by the use of a bed of latch needles the hooks of which are set back, in conjunction with an upper bed of displaceable points capable of reversing the position of the loops on the needles. The points may be put in action in stages to diversify the patterned effects obtainable. The points are cranked and provided with butts by means of which they are moved in a tricked cylinder so as to come in between the needles. The butts are engaged for this purpose by cams which give the points the necessary vertical movements. The lower ends of the points are deflected to ensure them entering between the yarns by means of an arm fixed to the latch guard. The butts can be removed from the influence of the cams by the action of radial sliders mounted in a bed. When the slider butts travel in the cam track the sliders are idle but when the butts are transferred to a second track the inner ends of corresponding sliders press on the upper ends of the corresponding points and remove their butts from the cams. The slider butts are transferred in groups by the action of projections on a pattern wheel. —B.C.I.R.A.

Loom Driving Mechanism. E. Hollingworth, Dobcross, Yorks. E.P.251,877.

A loom which is driven by a motor through a clutch is provided with means for preventing the clutch shipper handle from being mechanically held in driving position when the motor is reversed and for preventing reversal when the handle is held in driving position. The handle is normally held in driving position in the usual notch in a slotted bracket. The motor is controlled by a switch, the handle of which is linked to a lever pivoted to the bracket and having a lug extending towards the slot in it. When the loom is working normally, reversal of the motor without first stopping is prevented by the engagement of the lug with the clutch shipper handle, and when the switch handle is in reverse position the lug covers the notch and prevents the shipper handle being placed therein.
—B.C.I.R.A.

Loom Change-box Motion. A. Barbier, Lyons, France. E.P.252,286.

In a drop-box motion for 12 boxes, four pinions arranged rectangularly are rotated on their respective shafts by toothed sectors on a central rotating plate, the rear faces of one set of sectors being in the same plane as the front faces of the second set. The pinions are clutched at times to respective coaxially mounted discs, which

severally control levers each allowing of a rise of one to four boxes. The disc and lever mechanism is described.
—B.C.I.R.A.

Pile Fabric Loom Creel Frame and Warp Letting-off Device. L. Lafond, St. Etienne, France. E.P.252,564.

In looms for weaving velvet fabrics face to face, the pile warps are drawn from bobbins mounted on spindles on a steeply slanting frame. Each spindle carries a spring in engagement with the adjacent bobbin. The warps pass through a comber board and through needles to a warp-clamping drawing-off device. The clamping device comprises a fixed jaw having a facing of rubber, and a lower cam-controlled jaw having a wooden sheathing provided with a facing of glass paper or emery paper and a brass or iron rod arranged above the facing to prevent injury to the warps. When the clamp is closed, a bar is moved so as to draw off warps sufficient to form the pile, the tension being maintained by the needles in front of the comber board. The breast beam is slotted and a loop of the fabric passes therethrough under a roller, whereby when the pile threads are severed by a knife the tension of the web prevents the pile threads from being pulled out. —B.C.I.R.A.

Loom Double Picking Motion. Bergmann Electricitäts-Werke A.-G., Berlin. E.P. 252,665.

A loom is provided with two picking motions, one being dependent on the speed of the loom and the other independent thereof. At low speeds, the picking is effected by a spring-operated vertical lever provided with a lateral fork to engage a roller for actuating the picking arm. The operating spring is charged by a cam on a shaft. At higher speeds a tappet on the same shaft is adapted to engage the roller, the vertical arm being held in an inoperative position by a latch and lever connected to the starting and regulating device. When the loom is started, picking is effected by the spring-operated lever, the tappet being inactive. When the loom is reversed the lever is held in the latched position. Specification 242,255 is referred to. —B.C.I.R.A.

Loom Shuttle. Lucas-Lamborn Loom Corporation, New York. E.P.252,709.

The weft passes between an eye in a transverse plate and a passage in the end of the shuttle which has its inner end on the axis of the shuttle. The weft is tensioned by a lever pivoted to a flange on the transverse plate. To thread the shuttle the weft is passed over a prong on the plate through passages to the eye; at the same time the thread is passed into a flared slot in the shuttle end which leads into the first-named passage in the end of the shuttle. The passage of the thread raises the tensioning lever to a position inclined at a small angle to the rest position. The plate is positioned in grooves in the shuttle by a stop. The shuttle ends are pyramidal. —B.C.I.R.A.

Non-woven Fabrics: Manufacture. E. O. Munktell, Stockholm. E.P.252,719 and 252,720.

(1) A fabric for towels, table cloths, &c., is produced by passing a number of layers of cellulose, cotton, or wadding or of soft and strong paper through goffering rollers and then spraying with an impregnating liquid which may comprise water, starch, borax, Japan wax, &c. The impregnated layers are then pressed, the goffering being smoothed out. The material may be passed through a pattern press to obtain an appropriate finish. For impregnation, solutions of cellulose esters, gelatine, or casein, &c., may be used with the addition of hardening agents or of softening agents.

(2) Similar fabrics are made by pressing together impregnated and unimpregnated layers of fibrous material such as crimped or uncrimped cellulose, cotton, wadding, &c. Impregnating materials are as before. The layers may be assembled in runaways, in which those layers to be impregnated are sprayed, after which the layers are brought together and compressed. The impregnated and unimpregnated layers are arranged alternately and two, three, or more layers may be used. A goffering operation may be performed. Finishing is performed by passing through smooth rollers. —B.C.I.R.A.

Jacquard Card Punching Machine. Würker Ges., Dresden, Germany. E.P.252,734.

A punching mechanism for reproducing perforated pattern strips or jacquard cards is described. —B.C.I.R.A.

Knitting Machine Tension Control Device. A. Morris, Leicester, and Klinger-Stern Hosiery Mills, Ltd., London. E.P. 252,781.

A tension control device such as a cam regulating the length of loop by operating on the stitch cam is actuated by the pattern chain at times corresponding to predetermined points in the length of the fabric knitted. The spindle of a known yarn control device consisting of a selector drum with studs acting directly on yarn fingers carries another similar drum on which studs are mounted in such a way as to be the equivalent of a snail cam. These studs pass under a lever and depress a spring plunger connected to the stitch cam. The driving mechanism of the drums is described. —B.C.I.R.A.

Loom Shuttle Swell. H. V. Carver, North Carolina. E.P.252,819.

A metal plate bolted to the shuttle binder is furnished with a sleeve to receive a bushing mounted on a bolt, which is adjustably secured in aligned slots in the horizontal limits of a channel-shaped bracket

on a casting bolted to the lay. The binder, can thus rock about the pivot, an adjustable screw acting as a safety stop in case the bolt should be loosened. The binder which is of wood, has a swell covered with a facing of leather, and it has an end facing of rubber to contact with the protector thumb. A portion of the bush is cut away and has two holes to receive the feeler fingers in case the binder is used on an automatic loom. —B.C.I.R.A.

Loom Change-box and Take-up Motions. H. Taylor and J. N. Leigh, Bolton. E.P.252,859.

In looms for weaving terry fabrics, the dobby has one or more ordinary cylinders and an additional cylinder for controlling the shuttle box motion, the take-up motion, the terry motion. and the let-off devices. The feeler levers operated by the additional cylinder are connected by Bowden wire devices to the ordinary feeler levers controlled by the ordinary cylinders, and these former levers control respective dobby levers connected by Bowden wire devices to the shuttle box motion and the take-up motion, &c. When the dobby lever controlling the take-up mechanism for producing fringe effects is operated, it operates a lever by means of a Bowden wire device, a bowl on an arm on the lever then moving away from a projection on a second pivoted lever. The second lever is then actuated in one direction by a spring and in the other by a pin fixed to the lay sword and to a vertical lever. At the same time, the bowl allows a spring-controlled pawl on the second lever to move into engagement with a ratchet wheel fixed to a pinion geared to a wheel on the shaft of the take-up beam. This is thus rotated to form a fringe. During this action the beam of the ordinary take-up motion is retained from rearward movement. —B.C.I.R.A.

Loom: Weft Stop-motion Device. T. W. Payton, Castleton, near Manchester. E.P.252,873.

The boundary frame of a weft grate or grid is bent to incomplete form from bright drawn mild steel wire to receive a separate bent bracket which is secured thereto by autogeneous soldering or welding. The bars of the grid are secured in slots or holes in the frame by welding or riveting. Horns may be provided on the bracket for securing to the frame. —B.C.I.R.A.

Circular Knitting Machine: Embroidery Mechanism. W. Spiers, Leicester. E.P.252,883.

The specification relates to the application of embroidery attachments to machines of the super-posed cylinder type. The invention is described as applied to a machine with rotary needle cylinders. The rib cylinder rotates about a bearing sleeve and is supported by balls on a sliding sleeve. An inner sleeve is rotated in unison with the rib cylinder. To the lower end of the inner sleeve is attached a conical dial tricked to receive one or more patterning yarn carriers, the butts of which are operated by a stationary cam carrier on the end of a centre bar. The ends of the sliders (yarn carriers) are offset so that the yarn eyes are not in line. When a slider is projected the space between the yarn and the offset part of the slider is brought over the corresponding needle so that the needle on rising may enter to take the yarn. The rib cylinder may be raised to provide clearance for the advance of the sliders by means of a pattern-controlled lever acting on the sliding sleeve. The cam and push rod mechanism for projecting and selecting the requisite sliders is described. —B.C.I.R.A.

Loom Reed Threading Machine Disc Control Device. S. S. C. Fleischer and J. K. E. Fredholm, Copenhagen. E.P.252,926.

In a machine for threading loom reeds of the kind having an oscillatory hooked disc slidable along a shaft and adapted to progress automatically from dent to dent of the reed, stops are provided for limiting the motion of the disc in its end positions, means being also provided for holding the disc in a third position in which it is free to slide along its shaft in the direction of the reed to correct any faults. The shaft carries a projection adapted to engage a stop in one direction and a step in a spring-controlled lever in its other end position. By depressing the latter lever the projection engages a second step thereby holding the disc in a position in which it is free of the dents, so that it can be moved along the shaft. —B.C.I.R.A.

Braiding Machine: Yarn Carriers A. E. White (for American Wiremold Co.) London. E.P.252,973.

The inner yarn carriers are each provided with a guide plate carrying a pivoted deflector which meets the oncoming yarns from the outer supplies and deflects them under or over the carriers as the case may be. The movement of the deflectors is effected by removable pins mounted respectively above and below the groove of the rotary outer drum in which the carrier shoes slide. The plates are made relatively long to reduce the period during which the outer yarns are free to vibrate. This is particularly desirable when asbestos, &c., yarn is worked. —B.C.I.R.A.

Knitting Machine Cylinder Drive. W. Spiers, Leicester. E.P.252,987.

Machines of the superposed cylinder type are provided with driving means for the cylinders or cam boxes consisting of a common shaft which is driven by bevel gears from the main driving shaft. Gear wheels on the common shaft drive wheels on the cylinders. In this way it is possible to maintain the cylinders strictly in register.

The top cylinder may be supported by means of a rod suspended from a plate, a thrust disc, and a series of balls. Specification 24,290/12 is referred to. —B.C.I.R.A.

Carpet Loom: Driving Control Mechanism. E. Hollingworth, Dobcross Loom Works, Dobcross, near Oldham (Crompton and Knowles Loom Works, U.S.A.). E.P. 253,035.

In carpet loom driving mechanism as described in Specification 251,877 a device comprising an interlocking electric motor controller and clutch is provided to warn the operator, when in reverse, as to the proper time for stopping the loom. —B.C.I.R.A.

Sheet Metal Mule Carriage. R. R. A. Hurst, Bolton. E.P.253,216.

In a mule carriage built from sheet metal, channelled cross bars are secured in position by sheet metal fixing members cut and bent to provide lugs which can be secured by bolts and rivets. —B.C.I.R.A.

Light Metal Loom Picker. G. Spencer, Moulton & Co. Ltd., and R. Glascodine, Westminster. E.P.253,264.

Pickers for underpick and overpick looms are cast, pressed, or stamped from aluminium, aluminium alloy, or other metal and have a screwed-on metal holder containing a renewable striking part of rubber or the like. The cast picker has a guide-lug and a picker-stick slot and is recessed to receive the screwed holder in which is moulded the rubber striker. Holes and grooves in the recess secure the rubber which contains an axial hole. The rubber may be solid throughout with a convex face. In a modification, the picker is formed in two stamped or pressed portions riveted together and has two cylindrical bores, one lined with brass, asbestos, or the like for the guide rod, the other for the screwed shank of the holder containing a rubber disc. —B.C.I.R.A.

Circular Knitting Machine: Patterning Mechanism. E. Brooksby, Leicester. E.P.253,319.

Plain or rib machines are provided at each feeder with a rotary pattern wheel consisting of a disc with radial grooves in which slide bits having a number of steps. Mounted on the stationary cover plate is a block on which are pivoted levers selected by screws projecting through the face of a ratchet wheel. When selected, the levers are depressed so that their ends project into the track of the corresponding steps of the bits, which are thus moved radially until their butts pass outwards through a gap in an annular rib of the cover plate. The selected bits are then in position to operate on the needles or sinkers; they are returned to the inactive position by a cam acting on the sides of the butts. The bits can be moved outwards irrespective of the levers for the purpose of permitting plain horizontal stripes to be knitted. The axles of the pattern wheels are inclined and the ratchets are driven by pawls operated by cams on the needle cylinder. According to the Provisional Specification the bits may be pivoted. —B.C.I.R.A.

Loom Picking and Shuttle-checking Mechanism. J. H. and T. Hindle, Haslingden. E.P.253,354.

In side lever under-pick motions particularly for wide looms for weaving heavy fabrics, the side lever carries a bowl for engagement by a cam pivoted at one end on a spider on the gear wheel of the tappet shaft, the other end of the cam being adjustably secured to the spider by a bolt and nuts. The bowl runs in an oil bath in a bracket. One end of the lever is pivoted to brackets adjustably secured to the loom frame. The free end of the lever engages a toe on the boss of the picking stick which is mounted in a box-shaped bracket mounted on the lay-sword shaft. The bracket is slotted to receive and guide the free end of the lever. To check the picking stick and, through the picking stick, to check the shuttle and picker, spring-controlled buffers are mounted on the bracket and are engaged by the boss of the picking stick. The picking stick and lever are returned to normal position by a spring. —B.C.I.R.A.

Loom Stop Motion. J. H. and T. Hindle, Haslingden. E.P.253,355.

In looms particularly applicable to weaving heavy wide fabrics and of the kind described in Specification 249,197, a number of tongues mounted on the stop-rod on the lay swords are adapted, when the shuttle is trapped, to engage a corresponding number of frog levers pivoted to the end and intermediate transverse frames. Each frog lever has a hole through which the corresponding tongue passes normally. Each lever is connected by a pair of tension rods adjustably connected to a rod passing through an abutment on the frame and engaged by a strong compression spring, so that the shock of bringing the lay to rest is transformed into a compression of the framing. The frog levers are pivoted so that they have approximately the angular motion of the lay. When the frog levers are operated the end frog lever engages a bell crank lever which is moved to operate a toggle lever and link work mechanism to withdraw a clutch to allow a heavy fly-wheel to run loose on the driving shaft and to apply a brake to a light brake drum fast on the shaft. A light hand wheel is keyed to the shaft. A starting handle connected to the toggle mechanism and a foot lever for releasing the brake where it is desired to turn the shaft by the hand wheel are also provided. —B.C.I.R.A.

Circular Knitting Machine: Thread Guide. G. Blackburn & Sons, Ltd., and T. Widdowson, Nottingham. E.P.253,374.

Dependent thread guides are operated indirectly by a central cam acting on intermediate swinging jacks. The jacks work between radial blades secured in a ring and are provided with butts. The butts are disposed at different levels on different jacks so that by raising or lowering the central cam different sets of guides may be operated at different times. The upper ends are retained in an annular recess of the ring by a clasp spring. The construction permits of the use of an independent guide for each needle. The central cam is exchangeable for others with operating surfaces at two or more levels. —B.C.I.R.A.

Jacquard Card Repeating Machine. A. McMurdo, L. Morrell, and J. McMurdo, Ltd., Miles Platting, Manchester. E.P. 253,381.

In a machine for repeating jacquard cards, the card to be punched and that to be repeated are moved step by step in longitudinal alignment under vertically reciprocating punches and feelers which are so inter-connected that the punches only operate when the corresponding feelers indicate a hole to be repeated. —B.C.I.R.A.

Knitting Machine: Yarn Supply Device. F. M. Reuther, Saxony, Germany. E.P. 253,415.

Knitted fabrics are provided with designs by twisting the component yarns together in a variable manner. If they are subjected to a hard twist the design appears as points or dots; when they are twisted loosely streaked or striped effects are produced. The yarns pass down through a spindle which may be rotated in either direction at varying speeds and over transverse pins by means of which the requisite twist is imparted. The yarns then pass to a guide or direct to the needles. —B.C.I.R.A.

Circular Knitting Machine: Transmission Gear. T. S. Grieve, Leicester. E.P. 253,465.

An adjustment of the transmission gears driving the cylinders is provided which allows the gears to be brought further into mesh for taking up back-lash due to wear so that the cylinders can be kept in register. —B.C.I.R.A.

Circular Knitting Machine: Patterning Mechanism. A. Morris, Leicester, and Klinger-Stern Hosiery Mills, Tottenham, London. E.P.253,473.

A tucking cam control device such as a slider acting on a star wheel controlling a tucking cam is connected by means of linkwork or otherwise associated with a counteracting device such as a slider. In this way tuck work may be made part way round a tube corresponding to the positions of the sliders which are preferably diametrically opposed. The sliders are controlled by a pattern chain the studs of which move them in unison either into or out of action with the star wheel. —B.C.I.R.A.

Jacquard Card Punching Machine. A. H. Lee, Birkenhead. E.P.253,622.

In a machine for punching jacquard cards and the like, the step-by-step card traverse and the punching head are automatically actuated, the latter under manual control, while the punches are selectively locked in the head by plungers, slidingly pivoted to bell cranks operated by means of keys arranged as in a piano. The machines are directly driven from a motor or belt-driven from a line shaft; when several machines are in line, a line shaft drives each machine through a clutch. —B.C.I.R.A.

Pile Fabric Loom: Yarn Selector. W. Felton, C. Willber, F. H. Oldroyd, and Turkey Rugs, Ltd., Radcliffe, near Manchester. E.P.253,630.

In a rug-making or like machine coloured yarns are selected in accordance with the pattern by a mechanism comprising a set of levers operated singly by a pattern band to raise a corresponding plunger into the path of independently moved means, which co-operate therewith to change the yarn. In the construction shown, the selected plunger is moved by oppositely reciprocating shifter-bars to a predetermined position; this movement shifts a carriage slidable on a bar and shafts to operate yarn-changing mechanism connected thereto. The plunger operating-means are actuated either mechanically or electrically. —B.C.I.R.A.

Looms: Warp Letting-off Motion. W. G. Gass and G. H. Ashworth, Bolton. E.P. 253,661.

The weighting lever connected to the rope or cord passing round the drum on the warp beam is pivoted and is provided with a weight having rollers resting on the flanges of the channelled lever. The weight is held in the required position by a perforated pivoted member co-operating with a projection on the weight. Tension may be removed from the warps by moving the weight to the right beyond the pivot. The weight has a portion projecting downwardly between the flanges to prevent it from falling off. In a modification the lever is solid, the weight having a portion projecting downwardly at each side. The weight may be moved along the lever by a hand-operated screw and nut device, or the ends of the weight may be connected by a chain passing over guide and jockey pulleys on the lever whereby the weight may be adjusted without going behind the loom. In another modification guide channels accommodate a flat link chain connected to the weight so that it can transmit pressure without buckling, a catch or stop being provided to hold the weight in adjusted position. —B.C.I.R.A.

Circular Knitting Machine. E. Brooksby, Leicester. E.P.253,692.

A rib machine is provided with a set of transfer points mounted in the lower face of a ribbing dial and adapted to transfer loops from the rib to the frame needles. The invention is described as applied to a machine with bearded rib needles and latch cylinder needles, and with stationary cam boxes or shells. The transfer points are each bifurcated at one end and are provided with butts at the other end. The bifurcations are of unequal length, a short bowed branch fitting into a cup formed in the long branch. The points are operated by means of a cam on a pivoted arm which is normally held out of action by a ring on which bear pins held down by a second ring. Cross pins on the second ring working in slots are pressed down by the shoe of a pattern controlled lever when operation of the points is required. The projected points then pierce the rib loops, the dial needles cast off, and the loops are stretched across the bifurcations of the points while the frame needles rise and enter. —B.C.I.R.A

Fabric Winding Roller. J. Strang, Ltd., and W. Strang, Ramsbottom, near Manchester. E.P.253,745.

A roller for beaming or winding on of fabrics has one or more bands or strip-like surfaces of a rough, adhesive, or friction-producing nature adapted to grip the fabric and extending from end to end of the roller. In one form the roller has grooves in which are placed strips of card clothing, the points of the wires forming a continuation of the periphery of the roller. In modifications, the grooves are filled with strips of india-rubber or strips of india-rubber or stabbed sheet metal are secured to the surface of the roller. In another form a strip of metal having alternate plain and stabbed parts is wound helically round a roller in such a manner that the stabbed parts form parallel strips. In a modification, a roller having a metal surface is stabbed to produce bands separated by unstabbed portions. —B.C.I.R.A.

Parallel Knitting Machine. Elitewerke A.-G., Abteilung Diamantwerke, Siegmar, Saxony, Germany. E.P.253,856.

A jacquard roller is moved up and down by a linkwork system acted on by the cam-carriage operating lever and consisting of a slotted link connected by levers to a roller and links connecting arms to the slotted link. The movement of the cam-carriage operating lever is limited by a rod mounted on a stud on the frame. The arms are mounted on a similar stud and the slotted link is mounted on both studs. The ends of the arms carry curved members forming channels engaged by a roller on the cam-carriage operating lever as the lever moves into its extreme position. This engagement causes the linkwork mechanism to move up and down. The slotted link is connected by levers with a pawl for feeding the chain wheel. —B.C.I.R.A.

Looms: Dobby Mechanism. A. Stuber, Thann, Haut Rhin, France. E.P.253,860.

The driving lever is driven by a rod adjustably attached to a pivoted slotted guide which is turned about its axis by a roller sliding in the guide and also in a fixed but adjustable guide having a central curved part and two straight parts. The roller is operated by a rod, a slider, a second rod, and a crank on the cam shaft. The slotted guide is turned until it is aligned with a straight part of the adjustable guide, after which the roller slides in the guides without turning the pivoted guide, thus producing a dwell. A modification is also described. —B.C.I.R.A.

Looms: Pirnless Weft Inserter. A. Mullor, Sceaux, Seine, France. E.P.253,861.

In continuous weft-feeding devices as in Specification 249,471, the thread-gripping forks on the "shuttle" are combined into a double-acting centrally located fork and a fixed thread-presenting guide is used, to which the thread is led from the supply spool through a tube oscillated by a cam and lever whereby an open U-shaped part of the tube is caused periodically to fit against a felt roll to brake the thread. The thread also passes through an eye at the end of a thread-tensioning spring on the tube. When the "shuttle" is picked, the thread is carried in loop form by the fork and when it nears the selvage is engaged by the wedge-shaped rear tailpiece of a thread-gripping hook which is oscillated by cam-controlled lever mechanism. The hook and tailpiece pass between the tines of the fork and the loop of weft is transferred from the fork to the hook which is moved to various positions to drop the loop of weft at the "selvage." —B.C.I.R.A.

Looms: Beat-up Motion. Vereinigte Seidenweberein A.-G., Amrath, near Crefeld, Germany. E.P.253,893.

The beat-up movements caused by a crank drive are influenced by a spring mounting. The lay may be carried by resiliently-mounted supports such as leaf springs secured in position by angular clamps, or tension or coil springs may be mounted on the lay shaft. The spring force assists the action of the crank drive and makes it more regular. —B.C.I.R.A.

Yarn Warping Mechanism. J. Goretzki, Richenberg, Czecho-Slovakia. E.P. 253,899.

In warping cotton, &c., each thread is wound off from the inside of a cop in a triangle-shaped bobbin and then passes through a brake. The threads finally pass on to a warp beam. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Weaving

252,984. H. J. & M. L. Thackeray. Hand-power looms.

Fabrics

251,764. A. Beaumont. Double blankets on 2/2 twill basis.

4—CHEMICAL AND OTHER PROCESSES

(A)—Boiling

Boiling-off Silk. *Text. Colorist*, 1926, **48**, No. 565, p. 54.

Silk may be degummed in water under pressure in presence of traces of alkaline matters, such as ammonia, soda, caustic soda, phosphate of soda, or borax. As an example: silk is treated for ½ hour in distilled water containing 0·25% caustic soda at a pressure of 7 lb. The lustre and feel are stated to be equal to those of silk boiled-off in a soap bath. —F.G.P.

(B)—Scouring and Degumming

Special Treatment of Silk. *Text. Colorist*, 1926, **48**, 616-617.

Brief descriptions are given of methods for preparing and dyeing souple silk, for degumming, softening, and lustring silk. —A.J.H.

Scouring Losses: The Chemica. Analysis of Cotton. R. G. Fargher and L. Higginbotham. *J. Text. Inst.*, 1926, **17**, T233-T246. —L.I.R.A.

Modern Wool Scouring Assistants. *Dyer and Cal. Printer*, 1926, **56**, 69.

Hexoran is a stable emulsion of carbon tetrachloride and is particularly suitable as an addition to scouring liquors for wool; it is volatile. Cykloran is less volatile and consists of an alcohol of high boiling point combined in varying proportions with a potassium-oleine soap. Cykloran M conc., Cykloran O, and Cykloran E contain decreasing quantities of the alcohol and increasing quantities of the oleine soap, their fat-emulsifying and dirt-removing powers decreasing and increasing respectively in the order named. Perpentol S is capable of emulsifying tar on wool and is of particular value to felt dyers. Oranit KS is suitable for assisting the penetration of wool by acids in carbonising processes. —A.J.H.

(E)—Drying and Conditioning

Bleached and Mercerised Cotton Yarns: Regain. E. Burlet. *Rev. Text.*, 1925, **23**, 1029 (from *Le Nord Textile*, 1925, No. 278).

The author has made experiments in which samples of five yarns, bleached, mercerised, and untreated were conditioned in a room under constant temperature and humidity conditions. The average regain at a temperature of 18·8° and 69% humidity was: raw cotton, 6·56; bleached, 7·14; mercerised, 9·51, the regains corresponding to the 8½% accepted regain for raw cotton being 9·25 and 12·32 respectively. The 8½% regain can still be retained for bleached cotton, therefore, whilst that for mercerised cotton is 12%. —B.C.I.R.A.

Artificial Silk: Conditioning. E. Burlet. *Rev. Text.*, 1925, **23**, 1135.

Since the regain of artificial silk may vary between 5 and 15%, it is proposed to adopt a method in which the artificial silk is conditioned in a normal atmosphere until it is in hygrometric equilibrium with the surrounding air. Experiments on cotton have shown that not many hours are required for cotton to reach this state of equilibrium; artificial silk would require a longer time. The "normal atmosphere" is determined by ascertaining the conditions of temperature and humidity under which the usually accepted regain is attained. —B.C.I.R.A.

Vacuum Yarn Conditioning Apparatus. Scheidecker Frères et Cie. *Rev. Text.*, 1925, **23**, 1143.

The yarns are submitted in a vacuum to treatment with warm atomised water, followed by cold atomised water, ensuring penetration to the centre of the yarn by the humidifying agent and condensation and fixation of the agent in the desired locality. A simple arrangement of pipes and valves enables the temperature and humidity to be accurately and easily controlled. With this apparatus the operation is complete in 2½ hours. The apparatus is illustrated but not described. —B.C.I.R.A.

Chamber Drying Machine Air Diffuser. Tomlinsons (Rochdale), Ltd. *Text. Merc.*, 1926, **74**, 480.

To prevent the air currents leaving the heating compartments from penetrating the drying room too rapidly, and to ensure evenness of distribution, a simple device comprising essentially a sloping tray divided into a series of small compartments is mounted in the bottom of the machine cells. The incoming hot air strikes the successively higher back walls of the small compartments and is deflected upwards. —B.C.I.R.A.

Drying Woollen and Cotton Materials: Theory and Practice. F. Kershaw and H. G. Black. *Text. Colorist*, 1926, **48**, 626-630.

A description of machines for drying yarns and loose, knitted, and woven materials by means of hot air. —A.J.H.

(G)—BLEACHING

Braam Chlorine Absorption Apparatus. *Textielind.*, 1924, **5**, 697.

A report is given of a Dutch official test on the absorption apparatus designed by Braam. The plant is recommended for use in all bleaching processes where a low chlorine concentration is necessary to prevent damage to the fibre, and for water disinfection, &c. —B.C.I.R.A.

Conditions Governing the Bleaching of Wool with Hydrogen Peroxide. S. R. and E. R. Trotman. *J. Soc. Dyers and Col.*, 1926, **42**, 154-157.

Factors responsible for the loss in weight and damage to the epithelial scales during bleaching have been investigated and methods have been suggested by the aid of which both of these may be minimised. The cause of the greater susceptibility of chlorinated wool to damage during bleaching is to be sought, not only in the bleaching itself but also in the processes which have preceded this operation.
—B.R.A.W. & W.I.

(H)—MERCERISING

Oxygen Absorption of Mercerised Cotton. See Section 6.

Contraction during Mercerisation Expressed Mathematically. See Section 6.

(I)—DYEING

Insoluble Azo Dyes: Application. O. W. Clark and E. R. Borho. *Amer. Dyestuff Rep.*, 1926, **15**, 311-314 and 337.

A practical account of the properties of the insoluble azo colours and their application to cotton. They are produced directly on the fibre by coupling diazotised aromatic amines with naphthols. —B.C.I.R.A.

Straw Dyeing: Modern Methods. C. Williams. *Dyer and Calico Printer*, 1926, **56**, 92-93.

Methods for dyeing straw materials with Celatene dyes are described. —A.J.H.

Waste Sulphite Liquors: Reducing and Stripping Power. M. G. Kotibhashker. *J. Soc. Dyers and Col.*, 1925, **41**, 361-362.

The reducing power of sulphite liquor prepared in the laboratory from Scotch fir was investigated with a view to the possibilities of utilising waste sulphite liquor as a reducing and stripping agent in dyeworks and for bleaching rags in paper mills. Comparative Indigo vat dyeings using hydrosulphite and waste liquor as reducing agents are described. The results in each case were similar and dyeing was even. Indigo-stripping tests with the liquor are described. —B.C.I.R.A.

Franklin Dyeing Plant. J. D. Murray. *Amer. Dyestuff Rep.*, 1926, **15**, 316-317.

The yarn is wound on compressible spiral or helical springs and dyed in a closed kier under a hydraulic pressure of 10 to 25 lb., according to the temperature of the dye liquor and the tight or loose condition of the packages. The yarn packages are compressed on hollow, perforated spindles on the dye kier. When dyeing is complete the surplus water is removed by means of a hydro-extractor or ordinary laundry wringer and the yarn is put in trays and placed in a drier. —B.C.I.R.A.

Mineral Khaki Colours: Application. S. L. Hayes. *Amer. Dyestuff Rep.*, 1926, **15**, 321-325.

A general account of the production of khaki colours on cotton fabrics by the fixation of salts of iron and chromium.
—B.C.I.R.A.

Colours of a By-gone Age for Spring. M. H. Rorke. *Amer. Silk J.*, 1926, **45**, No. 1, p. 39.

The new spring colour card of the Textile Colour Card Association of America contains a number of shades reminiscent of the French Court of the Eighteenth Century—La Vallière is a silvery mauve, Marie Antoinette a grey-rose, Polignac a shade of bois-de-rose, Maintenon is a brown-pink, and Chevreuse a pink-brown. Clear green blues are Monaco and Mediterranean, Cathedral Blue is said to reproduce the blended jades and amethysts of the windows at Chartres. Phantom Red is a brilliant scarlet with a hint of yellow. Crystal Grey is soft and has a pinkish cast; Metallic Grey suggests burnished platinum, Rosetta Grey is a rich dark colour. Lovebird is a rich green. —F.G.P.

Dyeing Vat Colours on Rayon. F. F. Warshaw. *Amer. Silk J.*, 1926, **45**, No. 1, p. 61.

Cotton tie bands on the skein should be used as they do not slip; the hanks are placed on carefully selected bamboo rods, which are free from splinters. Very great care must be taken in selecting dyes suitable for the purpose, always remembering the subsequent treatment of the dyed yarn and its ultimate use. When mixed dyes are employed it is essential that they are of such nature as will give the best results under similar circumstances. The trade can probably be educated to accept shades that will give better results in working than those selected. The yarn is wetted out in a bath of water containing a small quantity of hydrosulphite, caustic soda, glue, and monopol oil at 110° F. The reduced dye is put in portions in a bath suitably heated and the yarn immersed and given the required number of turns to exhaust the dye before adding more. When all the colour is on, the yarn is placed in the oxidation bath of bichromate and acetic acid or allowed to oxidise naturally. After washing and soaping, the yarn is whizzed and dried. Unevenly dyed skeins are sorted out, and if there is a harsh feel when dry the batch must be softened.
—F.G.P.

Ice Colour Vat Cooling Device. C. Winternitz. *Bull. Soc. Ind. Mulhouse* (Pli cacheté 1848 of 20/VII./1908), 1926, **92**, 163-164.

The ordinary wooden feed roller is replaced by a hollow iron or copper roller provided at one end with a screw cap through which an ice and salt or other freezing mixture is introduced. By this means the printing process can be worked for some hours at a room temperature of 30-35° C. The device may be applied also to dyeing with ice colours. —B.C.I.R.A.

Cotton-Artificial Silk Union Fabrics: Dyeing. H. Blackshaw. *Dyer and Cal. Printer*, 1926, **55**, 205 and 225.

A general account of methods of dyeing cotton-artificial silk piece goods. —B.C.I.R.A.

Woollen Piece Dyeing; Cause of Faults in——. J. S. Heuthwaite. *Dyer and Cal. Printer*, 1926, **56**, 66-67.

A description of common faults, their cause and correction, in dyed woollen piece goods. Variation of shade among pieces in the same batch is usually due to the presence of different qualities of wool used in their manufacture or variations in the process of preparation. For example, milling particularly affects the affinity of wool for mordants and dyestuffs according as it is carried out slowly or quickly. Unequal decatising frequently causes one end of the dyed piece to be darker than the other; the inner layers of the piece adjacent to the decatising roller gain an increased affinity for mordants and dyes. Dark and light "lists" are usually due to unequal distribution of liquors used in preparatory processes, e.g., acids in carbonising, and alkalis in scouring. Heat and milling creases are readily distinguished from each other, since the former are associated with felted fibres. Mildewed patches appear light or bare (in carded goods) after dyeing. —A.J.H.

Problems of Hosiery Dyeing. R. C. Spurgeon. *Dyer and Cal. Printer*, 1926, **56**, 94-95 (from *Canadian Text. J.*).

Paddle dyeing machines are most satisfactory. Penetration of seams, heels, and toes of all-silk stockings is ensured by degumming and dyeing simultaneously instead of successively; a mixture of sulphonated castor oil and sodium silicate is preferred for degumming since the resulting textile materials has a high lustre and soft handle. Hosiery containing artificial silk, natural silk, and cotton together is preferably degummed before dyeing. When dyeing sulphur colours on cotton mixed with real silk, the silk is degummed after dyeing the cotton since the gum protects the silk from deterioration by the alkaline dyebath. Excessive shrinkage is the most serious fault which occurs in dyeing hosiery containing wool; it may be avoided by reducing the duration of dyeing and the quantity of alkali used in scouring. —A.J.H.

Formic Acid in Textile Processes. H. O. Richardson. *Dyer and Cal. Printer*, 1926, **56**, 104-105.

The manufacture and uses of formic acid for assisting the mordanting of wool, the stripping of dyed fabrics and the dyeing of leather are discussed. —A.J.H.

Dyeing of Artificial Silk. E. Greenhalgh. *Dyer and Cal. Printer*, 1926, **56**, 106-107.

The concluding article of the series. Level dyeings on cotton and viscose silk brocade fabrics are obtained by dyeing below 60° C. until about 75% of the depth of shade is obtained, and then completing the dyeing while raising the temperature of the dye liquor to 80°-85° C., but without the addition of a further quantity of dye. Such brocade fabrics should not be singed over a hot-plate. —A.J.H.

Dyeing with Lichens. A. R. Horwood. *Dyer and Cal. Printer*, 1926, **56**, 110-111.

The application to textile materials of dye extracts obtained from lichens mainly obtainable in Scotland, e.g., archil, cudbear, and crottle, is described. —A.J.H.

Dyeing of Vat Colours. J. S. Heuthwaite. *Dyer and Cal. Printer*, 1926, **56**, 132-133.

The first of a series of articles dealing with methods for dyeing with indigoid, anthraquinone, and sulphide vat dyes. —A.J.H.

Azo Colours, Insoluble; The Composition of Some Products used for the Production of——. F. M. Rowe. *J. Soc. Dyers and Col.*, 1925, **41**, 354-356.

The author has investigated a number of compounds used for the production of insoluble azo colours, e.g., Naphthol AS-BR, Naphtholate AS, Brenthol H soluble 50% paste, various bases, fast salts, and Permanent Red 2G (AGFA) = Monolite Red 2G (BDC). —L.I.R.A.

Artificial Silk: Dyeing. J. Huebner. *J. Soc. Dyers and Col.*, 1925, **41**, 387-401.

A review of the literature of the last 11 years, including patents, on the dyeing and printing of artificial sil . —B.C.I.R.A.

Silk-Cotton Hose: Dyeing. H. D. Mudford. *J. Soc. Dyers and Col.*, 1926, **42**, 44-46.

A report of a lecture on the methods of dyeing natural silk hose with cotton tops and feet. —B.C.I.R.A.

Azo Dyes: Application. D. H. Peacock. *J. Soc. Dyers and Col.*, 1926, **42**, 53.

Azo dyes may be attached to cotton through the agency of a nitrobenzyl ether of cellulose and the subsequent reduction of the nitro group and diazotisation. Cotton

is boiled with a 1-2% solution of nitro-leucotrope (nitro-phenylbenzyldimethyl-ammonium chloride) washed and reduced with hydrosulphite solution at 60-70° and then, after washing diazotised; coupling with β-naphthol gives a rose shade. The feature of these dyeings is their fastness to washing. —B.C.I.R.A.

Mordant Dyes: Historical. G. T. Morgan. *J. Soc. Dyers and Col.*, 1926, **42**, 54-58.

In a lecture on recent researches on mordant dyes the production of mordant dyes and lakes is reviewed from the time of Pliny to the present day. —B.C.I.R.A.

Starches: The Behaviour of Different, towards Dyestuffs and Iodine. J. Huebner and K. Venkataraman. *J. Soc. Dyers and Col.*, 1926, **42**, 110-121.

Numerous experiments are described. It was found that the starches may be arranged in the following order with regard to the power of adsorbing basic dyestuffs—Rice, maize, potato, tapioca, wheat, sago. Some acid and direct dyes were absorbed by the starches in fair quantity but others to a small extent or not at all. Maize, wheat, and tapioca starches were found to absorb larger amounts of a direct dyestuff (Diamine Sky Blue) than did potato starch. The adsorption of Methylene Blue, Methyl Violet, and Magenta from aqueous solutions was found to follow the simple absorption law, the weight of dyestuff absorbed by a given weight of the starch being proportional to C^1/n where C is the concentration of the dyestuff. —L.I.R.A.

Dyeing Wool with Indigo. F. Peterhauser. *J. Soc. Dyers and Col.*, 1926, **42**, 152-154, *and J. Soc. Chem. and Ind.*, 1926, B535.

Indigosol O (*cf.* Voucher and Bader, *J. Soc. Chem. Ind.*, B, 1925, 864) is superior to indigo since it is easily soluble in water and may be applied to wool by methods used for acid dyes; it does not oxidise in the dyebath and allows the accurate matching of desired shades. Its subsequent development by oxidation is not satisfactory when hydrogen peroxide, a persulphate, or atmospheric oxygen is used. Indigosol OR and O4B are similar soluble derivatives of monobromo- and tetrabromo-indigo respectively.
B.R.A.W. & W.I.

Celanese; Fast-to-light Dyeing on——. G. H. Ellis. *J. Soc. Dyers and Col.*, 1926, **42**, 184-186.

The lecturer referred to the excellent fastness properties of the S.R.A. Celanese dyes and gave a list of these dyes selected for greatest fastness to light. He then pointed out the desirability of being able to make use of these colours in conjunction with light resistant cotton dyes for Celanese-cotton mixtures. If anthraquinone vat dyes are used, there is danger that the properties of the Celanese will be impaired by the alkalis used in the preparation of the vat. This difficulty has been largely surmounted by using the alkali salts of phenols (e.g. sodium phenate) in place of caustic soda. Not all anthraquinone vat colours are applicable by this process, but a considerable number are quite suitable and leave Celanese practically white. Further information is given in Dyeing Leaflets Nos. 5 and 6 (British Celanese, Ltd.). —L.I.R.A.

Indigosol OR and Indigosol Yellow HCG. *Chemicals*, 1926, **25**, No. 17, p. 32.

These are two new water soluble and stable vat dyes manufactured by Durand and Huguenin, S.A., Basle, Switzerland. Indigosol OR is a further addition to the indigosol group and is intended for the production of navy blues. Like the other members of this group, it is soluble in water and is quite stable. Its chief application is in calico printing, and, like Indigosol O and O4B, it is suitable for both print-on and resist styles. In fastness it corresponds to that of Indigo MLB/R. This new brand may be developed either by the steaming process or by the nitrite process, both processes giving, particularly on unmercerised goods, brighter blues than those obtained with Indigosol O. Indigosol Yellow HCG is also a further addition to the Indigosol range of dyestuffs. Like the other Indigosol brands, it is stable, soluble in water and is suitable for producing old gold shades. In combination with Indigosol O and O4B, it is possible to obtain valuable greens of very good fastness to washing. Indigosol Yellow HCG is chiefly intended for textile printing, both for direct printing and particularly for resist styles. In view of its stability when printed and its easy fixability, the new product is of interest for machine printing as well as for block and yarn printing. This brand is best developed by the steaming process. White resists with Hydrosulphite NF conc. or Rongalite C on Indigosol Yellow HCG are not quite satisfactory, but on the other hand very fine colour resists may be obtained with the aid of the nitrosamines of insoluble azo colours, or with various vat colours. Moreover, Indigosol Yellow HCG may be used as a resist under Aniline Black according to a process, patent which has been applied for by Durand and Huguenin, A.G. —L.I.R.A.

Dyer's Tannins: Properties and Application. H. O. Richardson. *Ind. Chem.*, 1926, **2**, 195-196.

The paper contains notes on the origin, extraction, and properties of the commoner tannins used in dyeing. —B.C.I.R.A.

Azo Dyes, Naphthol AS Dyes, and Ionamines: Application. F. M. Rowe. *Ind. Chem.*, 1926; **2**, 208-212.

A review of progress in the production of insoluble azo dyes on the fibre, including

a note descriptive of how the requirements for dyeing cellulose acetate are met by the ionamines. —B.C.I.R.A.

Cotton and Artificial Silk Union Fabrics: Dyeing. G. Rudolph. *Kunstseide*, 1926, 8, 147.

Directions are given for obtaining a single uniform colour tone in a union fabric of cotton and viscose or cuprammonium artificial silk. Substantive dyes, of which suitable examples are given, are used in the process. For light shades 2-3% of Marseilles soap, 0·5% soda ash, and 5% Glauber salts according to the shade required are added to the dyebath. Dyeing is performed at 30° and later at 40°. For deeper shades the percentage of Glauber salts is increased up to 15% and the temperature of the bath is first 40° and later raised to 70°. Artificial silk and also cotton as a rule dye deeper at higher temperatures. Should the artificial silk show a greater affinity for the dyestuff than the cotton, the steam must be increased to lower the temperature. Mercerised cotton gives better results than unmercerised. The amount of Glauber salts must be regulated carefully. More equal shades are obtained by the use of a good wetting agent; Nekala (1-1½ g. per litre) is recommended. —B.C.I.R.A.

Roughness of Dyed Silk Hosiery. *Silk J.*, 1926, 2, No. 20, p. 61.

Dyeing of silk hosiery employs the most harsh treatment in the entire silk dyeing industry. Poor silk speedily develops lousiness in rotary machines and even the best silk will break down. A heavy thread silk stocking will break more quickly than a light one and every effort should be made to get the process finished as quickly as possible, although the shade be sacrificed to some extent. Monel metal machines have proved good for hosiery dyeing. —F.G.P.

Present Day Plants for Dyeing Rayon Goods. R. Sansome. *Silk J.*, 1926, 2, No. 21, p. 50.

A dyeing machine is described in which the hanks are all turned together and when dyed may be lifted in one lot while another similar lot is lowered in the vat. The advantages of the machine are that the yarn is gently moved automatically with very little power, the entering and lifting are conducted very easily, the turning of the hanks ensures even dyeing, the operations of wetting, dyeing, and rinsing are performed in the one vat, the treatment is regularised by adjustment of the mechanism, and the dyer can take swatches at any moment by stopping the machine and lifting the whole batch. —F.G.P.

Artificial Silk: Dyeing. B. Schwärzel. *Leipziger Monats. Text.-Ind.*, 1926, 41, 194-195.

A short general article, with pattern sheet. —B.C.I.R.A.

Dyeing Acetyl Silk Yellow and Similar Shades. *Text. Colorist*, 1926, 48, No. 566, p. 109.

Tartrazine may be produced on the fibres of cellulose acetate and silk by making a cold mixture of dioxytartrate of soda dissolved in just sufficient hydrochloric acid and phenyl hydrazine in just enough acetic acid and working the fibre for 10 mins. before raising the bath to 122° F. maintained for 20 mins. By substituting para-nitro-phenyl-hydrazine an orange shade is obtained. Terra-cotta shades are formed in a single bath of nitrosamine and 1-2-4-toluylene diamine in presence of acetic acid. No mention is made of the fastness of these colours. —F.G.P.

Dyeing Piassava. *Text. Colorist*, 1926, 48, No. 566, p. 110.

Piassava is a fibre derived from certain kinds of palms. Blacks and browns may be obtained from basic dyes in weakly acid baths with or without alum, dyeing 10 mins. cold and 20 mins. at 160°-175° F. Improved fastness at some sacrifice of shade is got by dyeing at the boil. Acid dyes with a small addition of oxalic acid give good shades. Dianil colours used with Glauber's salt and soda ash are said to be satisfactory. —F.G.P.

Distributing and Non-distributing Acid Dyes for Silk. *Text. Colorist*, 1926, 48, No. 566, p. 111.

These names are applied to colours that dye slowly and evenly and those which rush on to the fibre unevenly. Boiled-off liquor may be omitted when the first sort are used on degummed silk, but is essential with the others. Distributing dyes can be used in compound shades, the others must be used singly. As there are many dyes lying between these extremes care is needed in dyeing. —F.G.P.

Omission of Boiled-off Liquor in the Silk Dyebath. *Text. Colorist*, 1926, 48, No. 566, p. 112.

It is stated that the functions of boiled-off liquor are to preserve the sericin in partly degummed silk and to assist level dyeing. As much silk is wholly degummed the first use is only partial and as Marseilles soap is often used for the second function the answer is in the affirmative. The fact that it is a very cheap commodity that would be otherwise thrown away is not alluded to. —F.G.P.

Water and Soap in the Dyeing of Silk. *Text. Colorist*, 1926, 48, No. 565, p. 37.

For the throwster and dyer the ideal soap is a hard white curd made from olive oil and caustic soda; olive oil foots of high grade may be used and the soap must be neutral. Formerly, the name Marseilles soap indicated this but of late years that name may mean anything, and much foots of very inferior grade is used. Adulterations with oils such as cotton seed, rape seed,

pea nut, corn, poppy, and sesame are frequent and unsatisfactory, and barytes and soap-stone are sometimes added as fillers. A suitable analysis is given—Fatty acids, 60-65%; sodium oxide, 6·5-7·5%; water, 27-33%; insoluble, not over 0·5%. Pure olive oil soap will readily dissolve silk gum, is easily dissolved in lukewarm water, and leaves no disagreeable odour. All water used for silk should be soft. Calcium and magnesium salts form soaps which stick to the fibres and prevent evenness in weighting and dyeing.

—F.G.P.

Basic Dyes on Silk. *Text. Colorist*, 1926, 48, No. 565, p. 38.

Where fastness to light is not a vital matter, basic dyes are valuable from their richness of colour and easy reception by silk. Moderate temperature and neutral baths are usually sufficient; unbroken boil-off liquor may be used if the silk is only soupled. In a few cases slight acidity is required—Methylene Blue, Rhodamine Scarlet, Rhoduline Orange, and Auramine. With tin-weighted silk, too, acid is needed, giving richer and fuller shades than on unweighted. The dye should be added in parts, allowing each portion to be absorbed before putting in the next. A temperature of 150° F. is usual but Fuchsine requires 176° F. With schappe silk, however, the bath should be gradually raised to nearly boiling. —F.G.P.

Investigation of Certain Pyrazolone Dyes for Wool, Silk, and Cellulose Acetate Silk. E. C. Jennings. *Text. Colorist*, 1926, **48**, 523-526.

The yellow, brownish-orange, and yellowish-orange shades obtained by immersing wool, silk, and cellulose acetate silk in warm solutions containing sodium dioxytartrate and of one phenylhydrazine, *a*-naphthylhydrazine, bromo-phenylhydrazine, and dinitrophenylhydrazine respectively have similar fastness to light on all fibres, the fastness of washing being about equal on wool and silk but inferior to that on cellulose acetate. Dyes produced from bromophenylhydrazine and *a*-naphthylhydrazine are insoluble, but those obtained from phenylhydrazine and dinitrophenylhydrazine are sufficiently soluble to dye wool, silk, and cellulose acetate silk from a hot solution. All the pyrazolone dyes referred to above and containing amino but no sulphonic acid groups are capable of direct application to cellulose acetate silk. —A.J.H.

After-treatment of Cotton Material dyed with Sulphur Colours. *Text. Colorist*, 1926, **48**, 542-543.

Methods for topping sulphur colours with Aniline Black, for after-treating with metallic salts, e.g., copper sulphate and bichromates, and with hydrogen peroxide are described. Bronzy shades may be corrected by treatment with a warm dilute solution of sodium sulphide. Sulphur colours may be effectively topped with basic dyes. —A.J.H.

Direct Cotton Dyes on Wool. *Text. Colorist*, 1926, **48**, 544-545.

Many direct cotton dyes—a list of such is given—may be used for the production of fast shades on wool. Dyeing is effected in a neutral bath and after-treatment with metallic salts, e.g., chromium fluoride or a bichromate frequently increases the fastness of shade. Diamine Fast Red F yields shade on wool equal in fastness to milling as those obtained with alizarin. —A.J.H.

Dyeing of Natural Silk Fabrics. R. Sansone. *Text. Colorist*, 1926, **48**, 595-598.

A description of suitable machinery. —A.J.H.

Dyeing Immunised Cotton with Acid Dyes. A. P. Sachs. *Text. Colorist*, 1926, **48**, 601-603.

Cotton immunised by means of *p*-toluene sulpho-chloride and subsequently treated under suitable conditions with ammonia, gains an affinity for acid dyestuffs. The dyeings obtained are reasonably fast to soaping, particularly with after-chrome, alizarin, and pyrazolone dyes. Methylamine, dimethylamine, ethylamine, benzylamine, and other aromatic amines may be used instead of ammonia, but the resulting cotton has a less satisfactory affinity for acid dyes. The basic characteristics of the treated cotton are due to the presence of combined amine groups. —A.J.H.

Temperature in Dyeing; Importance of——. *Text. Mfr.*, 1926, **52**, 242-243.

Individual dyes have their individual temperatures at which they have their greatest affinity for the fibre. Thus when two or more dyes are mixed it is unlikely that they are both working to the best advantage, and so, for any definite temperature the proportions of the two dyes must be adjusted to obtain a given shade. Again the rate of dyeing of the two colours may be different, one of the dyes going on to the fibre more rapidly than its companion. This may be overcome by raising the temperature so that the remaining dye is taken up from the dyebath. This, however, makes it difficult to dye uniformly successive baths of material. Many dyes do not require a boiling dyebath, satisfactory results may be obtained in the range of 190°-205° F. Excessive temperatures used with basic dyes tend to deteriorate the colouring matter and the temperature for these dyes should be held within a narrow range, say, 140°-160° F. When used for topping the temperature may be somewhat higher, but should not rise above 175° F. When dyeing with a padding machine a reduction of temperature will probably occur. With a combination of dyes this alteration in temperature will tend to break up the combination

of conditions that has been producing the desired shade. As the temperature falls off the several affinities of the various dyes are not likely to change in the same degree, the result being an alteration in the shade. —L.I.R.A.

Hosiery Dyeing Machine. *Text. Mfr.*, 1926, **52**, 303-304.

A machine for dyeing artificial silk hosiery is described, circulation of the dye liquor being obtained by means of live steam and compressed air. Friction and strain on the hosiery is thus avoided. —A.J.H.

Submerged Beam Dyeing Machine. Baldwin and Heap, Ltd. *Text. Merc.*, 1926, **74**, 503.

The actual dyeing apparatus is a tank in which there is fixed a perforated beam stem. The dye is pumped into the bath through the beam stem in such a way that it travels the whole length of the beam before it forces its way through the perforations and into the yarn. During the operations of washing, steaming, dyeing, and drying (by compressed air) the beam is rotated automatically. A test carried out on the machine by 30 cotton weaving firms in the United States showed the dyeing to be even all through the beam (carrying 300 lb. of yarn). —B.C.I.R.A.

Autoxidation of Sulphur Black Dyeings. *Text. Rec.*, 1926, **44**, No. 522, p. 66.

The most recent researches (by K. Brass) on the after-tendering of sulphur black dyed cotton materials indicate that tendering is avoided or reduced by afterchroming and by replacing soaping by a prolonged washing with hot water. Prolonged washing with water not only removes oxidisable sulphur from the dyed fabric, but it also deepens the shade. —A.J.H.

Dye Penetration into Cell Membranes. See Section 1C.

Dyeing Souple Silk. See "Special Treatments of Silk" in Section 4B.

Application of Vat Dyes. See "Cotton Cloth Printing" in Section 4J.

Dyestuffs Fastness Tests. See Section 6.

Dyestuffs: Light Sensitivity. See Section 6.

Dyehouse Economics. See Section 9.

(J)—Printing

Red and White Discharges on Dark Indigo Bottom. J. Pokorny. *J. Soc. Dyers and Col.*, 1926, **42**, 157-158.

The author enumerates six technical methods which have been proposed for the production of red and white discharges on a dark indigo bottom and describes in detail the following new method—Print 20 parts lead chromate powder, 40 parts starch-tragacanth thickening, 28 parts diazotised *p*-nitroaniline, 12 parts water. Discharge with hot hydrochloric acid and ferrous sulphate. The quantity of lead chromate must be varied according to pattern. The smaller the pattern, the more lead chromate is required. The usual naphthol preparation, i.e., β-naphthol or β-naphthol R (9 parts β-naphthol with one part F acid) and ricinoleic acid, can be used. The printing paste requires, as do all the six methods mentioned, a rather deep engraving, for instance, 22-24 lines, where for ordinary printing 27-28 lines are used. The paste is printed out of a copper trough with a brush and it is necessary to cool well, both in the pot and in the trough. If this is done, five to six thousand yards of goods can be printed without changing the paste. The best red is obtained on goods freshly padded with naphthol and discharged on the same day as printed. Hydrochloric acid 27° Tw. is used at 37° C. for discharging, with the addition of 30 g. iron sulphate per litre. —L.I.R.A.

Imitation Embroidery Fabric: Printing. J. Frossard, C. Rebert, and B. Lothareff. *Bull. Soc. Ind. Mulhouse* (Pli cacheté 2281 of 20/X./1913), 1926, **92**, 167-170.

To obtain relief effects in imitation of embroidery, the fabric is printed with a solution of cellulose acetate in acetic acid (or other cellulose derivative may be employed) and the solution precipitated with water. For precipitation, the fabric introduced between the cylinder and the engraved roller comes in contact with a second roller provided with a thick covering of wool which can be impregnated with water. Pigments resistant to acetic acid may be incorporated in the printing solution. In a criticism the process is stated to be an amplification only of a previous process of Ratignier. —B.C.I.R.A.

Coloured Tannin-antimony Reserves: Printing. A. Scheurer. *Bull. Soc. Ind. Mulhouse* (Pli cacheté 1999 of 11/V./1910), 1926, **92**, 165-166.

The white fabric is coated with tannin and then printed with a paste containing antimony salt, antimony oxide, and a basic dye, for example, Methylene Blue. For dyeing the ground the fabric is again coated with a paste containing tannin and a second basic dye. The fabric is steamed, passed into tartar emetic, washed and soaped. The basic colour present in the antimony salt reserve is fixed on the tannin deposited on the white fabric and reserves the super-printing of the ground. —B.C.I.R.A.

Printing Cotton by the Indigo-glucose Method. *Text. Colorist*, 1926, **48**, 617-620.

A discussion of methods; several recipes are given. —A.J.H.

Methods of Producing Direct Printed Effects on Silk and on Rayon Silk Fabrics. R. Sansone. *Text. Colorist*, 1926, **48**, No. 566, p. 99.

Ageing of small lots of printed fabrics may be carried out in a steam cot fitted with

lines on which the rack may be run in and out. Printing with Helindone vat colours yields very fast effects, some of which are quite bright. A suggested mixture is—250 pts. water, 230 dextrine, 80 glycerine, 60 Turkey-red oil, 60 soda ash, 150-300 dyestuff, 30 hydrosulphite, 25 olive oil.
—F.G.P.

Katanol: Application. R. Fischer. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 195-198.

A general summary of the uses of Katanol in printing. Katanol O is generally used for this purpose. Katanol W is a special product for half-wool dyeing and is only used in exceptional instances in printing, e.g., in half-silk printing. —B.C.I.R.A.

Developments in Calico Printing. R. Sansone. *Dyer and Cal. Printer*, 1926, **56**, 86-88.

Methods and machines for printing ice colours are described. Several recipes are given for orange, claret, brown, blue, and black shades. —A.J.H.

Native Indian Fabrics in Muttra (India): Printing. H. B. Shroff. *Indian Text. J.*, 1926, **36**, 229.

The printing industry of Muttra is primarily a cottage industry. The work consists mainly in the production of saries in imitation of the Sanganer style and of scarves, kerchiefs, and dhooties. Printing is seasonal and has to be stopped in the rainy season for lack of ageing, drying, washing, and clearing facilities. The designs in use are, on the whole, old ones, and there is very little improvement; there is a slight increase in the use of geometrical figures. The blocks are made from well-seasoned shisham wood free from knots. The design from a transparent paper is directly tapped by means of a sharp instrument in the form of a broken outline, and the block is cut by sharp taps, drills, and chisels. The blocks of Muttra have two distinctive features. The portions cut in relief are straight instead of tapering and the engraving is much deeper. —B.C.I.R.A.

Coloured Reserves: Printing. Koechlin Frères. *Bull. Soc. Ind. Mulhouse* (Pli cacheté, 1060 of 19/XI./1898), 1926, **92**, 161-163.

A foundation colour is printed on the fabric with a paste containing dyestuff but no mordant; the fabric is dried and superprinted with a design, generally a ground, with a convenient mordant. The colour of the foundation will only be fixed at the points superprinted with mordant. The operations may be reserved. To obtain foundations of one or several colours with white or multicoloured designs, the foundation is printed as before, but using appropriate colours for each roller, and superprinted with a convenient mordant. When the superprinted design is to be of several colours, i.e., a ground with coloured motifs, dyes which do not fix or which reserve the underlying colours are chosen for the motif colourings. With foundation colours obtained with alizarins, tannin colours may be chosen for the motifs. —B.C.I.R.A

Cotton Cloth: Printing. W. Cotton. *Amer. Dyestuff Rep.*, 1926, **15**, 325-334.

The following new developments in calico printing are discussed—The introduction in Europe of the so-called "Indanthrene houses" which produce and sell fabrics printed with Indanthrene dyes only, the use of vat dyes as colour discharges on vat colours and as colour discharges or resists under Aniline Black, the Indigosols and their uses, the use of the Rapid Fast colours, the naphthols and the use of Katanol in the production of discharge styles. Brief reference is made to the printing of artificial silk fabrics and in the discussion a method of dyeing with vat colours under pressure is described in which the liquor is pumped through the yarn and through piece goods under pressure of nitrogen drawn from a bomb. —B.C.I.R.A.

(K)—FINISHING

Calendering Linen Fabrics. G. Rice. *Text. Amer.*, 1926, **46**, No. 1, pp. 23-24.

The author describes the operation of calendering, which is stated to be accomplished by passing the cloth between the hard surfaces of smooth rollers resulting in an equal flattening of all the threads in the cloth and producing a soft, silky lustre. Attention is drawn to the special surface of each roller employed and also to the importance of the pressure being properly regulated. A high degree of pressure is needed between a paper and any kind of metal surface roller if brilliancy of finish is wanted, and a light pressure will do if a dull finish is required. The effect of the temperature of a metal roller on the gloss of the fabric is referred to. The embossing of linen fabrics is also dealt with and the principle of the embossing machine outlined.
—L.I.R.A.

A Simple Calender Guard. *Dyer and Cal. Printer*, 1926, **56**, 109.

A simple adjustable wooden guard suitable for placing before the "nip" of calendering machines so that the hands of operatives cannot be drawn between the bowls is described. —A.J.H.

Pin-plate Tentering Machines: Control. H. D. Martin. *Text. Rec.*, 1926, **44**, No. 518, p. 59 (from *Text. Colorist*).

The importance of tentering in finishing cotton fabrics requires that the process shall be as efficient as possible. Pin-plate tenters have many objections as compared with modern clamp-plate tenters, including retarded production, pin holes in the cloth selvages, more damaged cloth, higher cost

of repairs, less easy handling, more short lengths and more soiled cloth. Improvements which can be made in the pin-plate equipment when it is impossible to replace this by clamp-plate machines are discussed.
—B.C.I.R.A.

Cloth Raising. *Text. Mfr.*, 1926, **52**, 274-275.

The effect of quality of material, structure, twist, and ply of yarns, firmness of fabric and weave on raising is discussed.
—A.J.H.

(L)—Waterproofing

Methods of Waterproofing Textiles. *Text. Argus*, 1926, No. 101, 18th Aug., p. 7.

Mechanical, chemical, and electrolytic methods for rendering fabrics showerproof and waterproof are described. Fabrics waterproofed by the electrolytic formation of a basic aluminium oleate when the fibres may be dry cleaned (with benzene) without loss of its water-resistant properties, since the basic oleate differs from the normal aluminium oleate in being insoluble in benzene. —A.J.H.

Patents

Degreasing Wool. Societe Commaniale. F.P.584,383 (from *Melliand's Textilberichte*, 1926, **7**, 720).

The degreasing of raw wool may be brought about by extraction in a closed vessel with trichlorethylen. This may be done at low, as well as at high temperatures. After extraction, the solution is removed from the apparatus by evacuating or centrifuging and the wool is then quickly dried by means of a flow of hot air in vacuum. It then still contains all the other valuable constituents, especially the potassium salts, but mineral impurities are also present, which must be got rid of by suitable means.
—B.R.A.W. & W.I.

Yarn Conditioning and Cooling Apparatus. F. Kershaw. U.S.P.1,587,384 (from *Amer. Dyestuff Rep.*, 1926, **15**, 552).

The apparatus comprises a casing having conveyer chains at each side and transverse sticks mounted on the chains from which the hanks of yarn are suspended. A transverse retarding bar is located in the path of the lower ends of the hanks so as to retard all the hanks suspended from a single stick, and means are provided for projecting sprays of fluid on to the sides of the yarn on each side of the opening formed by the retarded hanks.
—B.C.I.R.A.

Urea Application. Raduner & Co. A.-G., Horn, Switzerland. E.P.251,993.

Fibrous materials are finished by means of solutions containing urea. In an example, a dressing liquid for finishing cotton fabrics consists of starch solution to which urea is added. Urea may be added to the final bath before drying dyed vegetable or animal fibres. —B.C.I.R.A.

Silk: De-mineralising. British Silk Research Association, W. S. Denham and W. Brash, London. E.P.252,064.

The mineral content of silk is reduced and the retention of a deleterious proportion of acid avoided, without the consequent washing in pure, softened, or alkaline water to remove such excess acid, by treating the silk with an amount of acid not considerably in excess of that required to bring it to the iso-electric condition. The strengths of the solutions used should not be substantially greater than that represented by the pH value 3·8. In an example, 25 grams of degummed mulberry silk are immersed for 24 hours in 2,000 c.c. of distilled water containing 0·00063% of free nitric acid, wrung out, soaked again for one hour, wrung out again, washed with distilled water, and dried and conditioned. The dry ash was reduced from 0·55% to 0·04%. —B.C.I.R.A.

Tentering Machine. J. M. Clerc-Renaud, Villeurbaune, Rhône, France. E.P. 252,323.

In a fabric finishing machine wherein the tentering chains pass round two series of drums so that the fabric moves in a zig-zag path, the drums in each series are of such diameters or are so spaced that the angle between the warp and weft threads at successive undulations gradually decreases from the entry end to the exit end of the machine. One series of drums are adjustable to and from and to a small angle relatively to the other series. The feed rolls, winding-on drum, &c., are driven through variable speed gearing by means of ropes and expanding pulleys.
—B.C.I.R.A.

Alkaline Phenol Solution. L. de Wolf, Lebbeke, Belgium. E.P.252,360.

In a process for treating vegetable textile fibres, applicable also to yarns and fabrics, the defibering, scouring, and bleaching is effected more rapidly and lanification, mercerisation, and gelatinisation facilitated by the addition of a phenol to an excess of alkali. Monovalent or polyvalent phenols and their homologues may be used. Where bleaching is to be effected, oxidising agents acting in an acid, alkaline, or neutral medium may be used. Alkaline hypochlorites and permanganates are mentioned. As an example, jute is soaked in an oxidising bath, rinsed, wrung carefully, and subjected for 5-15 minutes to a solution containing 1 vol. of 38° Bé. caustic soda and 1 vol. of 33% phenol, then wrung, rinsed, and dried. —B.C.I.R.A.

Azo and Vat Dye Mixtures. I.G. Farbenindustrie A.-G., Frankfort-on-Main. E.P. 252,384.

Cotton is dyed with mixtures of vat dyes and insoluble azo dyes by impregnating with a mixture of an azo coupling component and a vat dyestuff dissolved in the

usual way, and then simultaneously oxidising the vat dyestuff and developing the azo dyestuff by applying a diazo solution. Almost any vat dyes may be used and the azo coupling components are specified. In examples (1) a green shade is obtained on cotton by impregnating with diacetoacetyl-*o*-tolidine and leuco 4 : 4[1]-dioxyindanthrone and developing with an acetic acid solution of diazotised *o*-chloraniline or 2 : 5-dichloraniline; (2) a brown shade is obtained by impregnating with 2 : 3 - oxynaphthoylaminohydroquinonedimethyl ether and leuco trichlorindanthrone and developing with diazotised 2 : 5-dichloraniline; (3) a bluish-red on cotton or artificial silk by impregnating with 2 : 3-oxynaphthoic-*m*-nitranilide and leuco succinyldiaminoanthrarufin and developing with diazotised 4-nitro-2-anisidine: in each case the material is first introduced into a solution of the coupling component, the reduced vat dyestuff added, and the material centrifuged and developed in the diazo solution. —B.C.I.R.A.

Wetting and Dispersing Agents. I.G. Farbenindustrie A.-G., Frankfort-on-Main. E.P.252,392.

Liquids are emulsified and solid and liquid materials wetted or dispersed with the aid of an aromatic sulphonic acid which contains at least one alkyl group and at least one halogen atom, nitro, hydroxyl, or amino group; benzyl-anilinesulphonic acid and acids having tanning properties are excluded. The acids may be used as substitutes for soaps, for emulsifying organic liquids in water, and for dispersing dyes, &c. In examples, a solution of the sodium salt of the product obtained by sulphonating alphachlornaphthalene and condensing with isopropyl alcohol is used for the wetting of wool and for the production of lather; a readily wettable and finely dispersed dye preparation is obtained by mixing with a dyestuff such as Indanthrene Blue RS, a solution of the sodium salt of diethyl-metanilic acid or of diamyl-alphanaphthylamine sulphonic acid; a cleansing and washing agent is prepared by mixing with methyl-cyclohexanone the sodium salt of di-butylaniline-sulphonic acid. —B.C.I.R.A.

Hank Dyeing Apparatus. P. Caldwell, Newton Heath, Manchester. E.P. 252,507.

In apparatus for dyeing hanks comprising a frame having top and bottom rollers, the frame is totally immersed in the liquor and is suspended from crank arms oscillated by pitmen. The upper rollers are geared together and are oscillated by mechanism comprising a double pawl mounted between arms pivoted on the shaft of a ratchet wheel and connected by a link to a lever from which depends a weighted cord. —B.C.I.R.A.

Hydronaphthalene Scouring Agents. L. L. Lloyd, A. Womersley, C. Wilkinson, and A. Scott, Bradford. E.P.252,811.

A scouring process for textiles comprises treatment with either (1) the condensation products of the hydrogenated naphthalenes with fatty acids, or (2) the sulphonic acids of the hydrogenated naphthalenes or the alkaline salts of these acids, or (3) the condensation products of these sulphonic acids or salts with the fatty acids. The fatty acids specified are oleic, and those from castor, arachis, olive, or cotton seed oils. —B.C.I.R.A.

Detergents; Preparation of——. I.G. Farbenindustrie A.-G., Frankfort-on-Main. E.P.253,105.

Saponaceous or Turkey-red oil and like compositions suitable for use in hard or salt water or with acid dyebaths and for washing and fulling fabrics and in carbonising baths comprise a hydro-aromatic or aromatic sulphonic acid or salt of high wetting power. An organic solvent, sulphite cellulose liquor or both may be added. The compositions may be prepared by mixing the acid or its salt or a concentrated solution of it with fused soap, or kneading or mixing the soap and dry salt together, or by adding the acid during the saponification process. Twenty parts by weight of acid or salt to 80 parts of soap is suitable. Borax, alkali silicates, glycerol, benzine, alcohols, cyclohexanol, ethylene glycol, mono ethyl ether or other solvent may also be added. Sulphonic acids specified are those obtained by condensing hydroaromatic or aromatic sulphonic acids with aliphatic, hydro-aromatic, or aromatic-aliphatic alcohols; condensation products of formaldehyde with naphthalene sulphonic acids; or sulphonic acids containing halogen, nitro, amino, or hydroxyl groups. —B.C.I.R.A.

Spot-dyed Knitting Yarns; Production of——. H. E. van Ness, Elmira, New York. E.P.253,461.

Cops of partially dyed yarn for knitting mixtures are dyed in band-like portions extending all or part way round it, the dyed portions reaching from the outer surface to the surface where it is in contact with the core. Spotted yarns so produced may be sufficiently regular in character to give an indication of the appearance of the knitted product obtained therefrom. The dye may be applied by the method described in Specification 205,057, or by dropping or wiping the dye on the predetermined part of the yarn mass during its formation in the winding machine. —B.C.I.R.A.

Dyeing Machine. J. Schlumpf, Winterthur, Switzerland. E.P.253,500.

In apparatus for circulating liquids through materials by means of a rotary pump the vats for the materials and the pump are made relatively movable so that one pump

may be employed for a number of vats. In one form, a vat of wood is mounted on rollers so that it may be brought up to a rotary pump having branches and a reversing valve actuated by gearing. The vat has a medium wall in which is an opening and one side of the vat is constituted by a stationary wall through which the branches lead, connected to the vat by clamping rods, a tight joint being made by rubber bands. In a modification, the pump is mounted on a carriage together with an electric motor and a reservoir for liquid and is moved up to a stationary vat.

—B.C.I.R.A.

Dyeing Machine. J. Schlumpf, Oberwinterthur, Switzerland. E.P.253,657.

In apparatus for dyeing, &c., rods of tapering section for supporting hanks or skeins are mounted in racks each comprising a lower member formed with two grooves, one carrying a resilient packing, on which the rods rest, and the other a notched strip of leather, canvas, indiarubber, &c., by which the rods are spaced apart, and an upper member of similar construction and adapted to be pressed down on to the rods to keep them in place. A glass rod on the upper member prevents the skeins from chafing against the racks. In a modification, the strip is replaced by teeth formed on one of the members, one side of the teeth having less inclination than the other to allow the rod to be inserted in an inclined position and then to be turned upright for clamping.

—B.C.I.R.A.

Cloth Raising Machine. R. Haddan, London. E.P.253,752.

In a napping machine, the carding pins on one-half of each roller point in the direction of travel of the cloth over the napping-drum and the pins on the other half in the other direction, the rollers being driven by the action of two webs of cloth to be napped without other gearing. The halves of the rollers may be of different diameters and ball bearings may be provided for the rollers. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Dyeing

252,240. C. M. Barnard and British Alizarine Co. Compounds for dyeing cellulose esters.

253,662. C. S. Bedford. Chrome-mordanting process for wool.

253,865. I. G. Farbenindustrie A.-G. Silk dyeing with azo dyes.

Washing

251,669. E. C. Duhamel & Cie. Generale des Industries Textiles. Apparatus for washing wool and other textile materials.

5—LAUNDERING AND DRY CLEANING

Textile Soaps: Comparative Emulsifying Powers. D. M. Simm. *J. Soc. Dyers and Col.*, 1926, **42**, 212.

Experiments have been made with Donnan's drop number apparatus with the object of determining the comparative emulsifying powers of different textile soaps. The results obtained indicated that but little reliance can be placed upon the test, the apparatus used, the age of the solution, and the oil with which the emulsifying power is measured influencing the results. The experiments showed, however, that the drop number increases with the concentration of the soap solution to a maximum of about 0·5% to 0·8%.

—L.I.R.A.

PATENTS

Ink-removing Composition. M. A. Lange. U.S.P.1,584,871 (from *Chem. Abs.*, 1926, **20**, 2233).

The composition comprises 1 part phenol, 2 parts alcohol, and 2 parts benzene.

—B.L.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Laundering

252,976. S. G. Jowitt. Washing machine: oscillating receptacle.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Wood: Constitution. B. Holmberg and S. Runius. *Chem. Zentr.*, 1926, **i.**, 136-137 (from *Svensk. Kem. Tidskr.*, 1925, **37**, 189-197).

On the assumption that in wood lignin and cellulose are chemically combined, the combination may be of the ester type with lignin as acid and cellulose as alcohol component or of the acetal type with lignin as the carbonyl and cellulose as the alcohol component or the reverse. If the ester type exists, ethoxylignin should result when wood is acted on either by an alcoholate or by alcohol and acid and should be saponifiable to lignin. If the combination is of the acetal type, and since acetals are stable towards alkali, alcoholate should not act on wood, but acid and alcohol should effect acetal formation with the production of ethoxylignins, stable to alkali, if lignin is the carbonyl component or form lignin if this is the alcohol component. Experimental work on the above basis is described in detail. Sodium alcoholate was without action on wood. By treating wood with alcohol and hydrochloric acid a product

designated "alcoholysis lignin" was obtained containing 19·38% alkoxyl (calculated as OCH_3). This product was unsaponifiable with alkali. The conclusion is drawn that the combination of lignin and cellulose in wood is of the acetal type with lignin as the carbonyl component.

—B.C.I.R.A.

α-Cellulose: Estimation. H. Bubek. *Papier-Fabr.* (Fest-u. Ausland-Heft), 1926, 66-71.

A new method of determining α-cellulose is described based on the fact that, of a cellulose mercerised with 17·5% by weight of caustic soda solution, a maximum goes into solution on diluting the mercerising liquid to 8-9% by volume. The following definition of α-cellulose is accordingly proposed—α-cellulose is that constituent of a cellulose which, after ½-hour mercerisation with 17·5 weight per cent. of pure caustic soda solution at a temperature maintained at 18° C., is insoluble in 8-9 volume per cent. of caustic soda solution at room temperature. The method of analysis is described and the results are in agreement with the definition. The maintenance of a definite mercerising temperature is essential; over a temperature range of 12-27° the value for α-cellulose increases with increasing temperature. Short time differences in the period of mercerisation do not greatly affect the results. By a 1½-hour mercerisation as compared with a ½-hour mercerisation, the maximum lowering of the α-cellulose value over a series of celluloses was only 0·36%.

—B.C.I.R.A.

α-Cellulose: Estimation. H. E. Wahlberg. *Amer. Dyestuff Rep.*, 1926, **15**, 398 (from *Svensk Pappers-Tidning*, 1926, 1st Jan.).

In a criticism of Schwalbe's results the author describes determinations of the α-cellulose content in artificial silk cellulose which he has made by the Waentig and the Jentgen methods. More consistent results are obtained by the latter method.

—B.C.I.R.A.

Cellulose: Estimation. N. Bengtsson. *Chem. Zentr.*, 1926, **i.**, 3355 (from *Mitt.* No. 279 *der landwirtschaftl. Zentralversuchsanst.* (*Schweden*), *Bacteriolog. Abhandlung*, No. 37, 1925, 1-13).

A method is described for estimating cellulose from straw sawdust, fertiliser, moss, lignite, &c., in soils. After treating with sodium bisulphite and hydrochloric acid under pressure the residue is dried and the cellulose dissolved with Schweitzer's reagent. The cellulose is reprecipitated with 80% alcohol. Details of the method are given. —B.C.I.R.A.

Cellulose and Starch: Adsorption from Alkali Solution. S. Liepatoff. *Kolloid-Z.*, 1926, **39**, 9-14.

The rate of adsorption of alkalis from alcoholic solution by starch and cellulose is slow and is considerably higher in dilute than in concentrated solutions. The rate of adsorption is the rate at which concentration is equalised in the boundary between the two phases. This equalisation is effected by diffusion. The rate of adsorption is directly proportional to the diffusion constant and the total surface area of the adsorbed substance, and inversely proportional to the thickness of the diffusion film. The rate of adsorption increases with increasing temperature.

—B.C.I.R.A.

Cellulose Acetates: Cryoscopic Properties. Kurt Hess and G. Schultze. *Annalen*, 1926, **448**, 99-120.

The abnormal cryoscopic behaviour of crystalline cellulose acetate is explained. If prepared crystalline cellulose diacetate dissolved in glacial acetic acid is placed in a freezing point apparatus in the usual way, the molecular weight reading decreases with time to a value below that of the simple cellulose diacetate molecule (molecular weight, 255). If the cellulose diacetate is dissolved at a temperature of 60° and the solution then frozen, the molecular weight increases on standing to a maximum and then decreases, again to a value below 255. By experiments on gas absorption by glacial acetic acid and acetic acid-cellulose acetate solutions, the cause of the anomalous behaviour of the cellulose diacetate was traced; and cryoscopic determinations made *in vacuo* gave minimum molecular weight values approximating closely to 255. A similar confirmation of the assumption that a C_6-group is the structural element of polysaccharides is afforded by cryoscopic molecular weight determinations of cellulose triacetate and lichenin acetate which also give limit minimum values of 255. —B.C.I.R.A.

Wood Cellulose: Whiteness Test. H. Wenzl. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 409-410.

In connection with the author's method of determining the "white content" of bleached wood celluloses by means of the Ostwald half shadow photometer he now lays down conditions as regards physical condition and strength to be fulfilled by the specimens under test. Since even the most highly bleached samples of wood cellulose show colouration, colour filters which eliminate red or yellow tinges must be used. Appropriate filters are shown.

—B.C.I.R.A.

Mercerised Cellulose: Oxygen Absorption. W. Weltzien and G. zum Tobel. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 413-414.

Mercerised cotton cellulose takes up oxygen in large quantities at room temperature and in greater amount as the temperature is raised. The oxygen absorption curve given for bleached cotton wadding placed in a vessel filled with oxygen and maintained

at a temperature of 60° for 41 days, shows a continuous increase in oxygen absorption. The experiment was stopped before any end point was reached; the amount of oxygen taken up during the experiment exceeded 1 mol. O_2 per $C_6H_{10}O_5$ group.
—B.C.I.R.A.

Starch Solution: Preparation. C. L. Alsberg, E. P. Griffing, and J. Field. *J. Amer. Chem. Soc.*, 1926, **48**, 1299-1300.

Dry starch is ground in an ordinary pebble mill until most of the granules are seen, under the microscope, to be cracked or frayed. The length of the grinding varies with the size of the mill, its charge and speed, and the variety of starch. About 2% of ground starch is sifted slowly into distilled water which is being agitated by an electrical stirring device and stirring is continued for about 1 hour. The liquid is centrifuged at about 2,000 r.p.m. for ½-1 hour and the supernatant solution is decanted and stored in an ordinary bottle with enough toluene to cover the surface. Wheat starch gives a clear solution. Potato starch gives an opalescent solution but the opalescence can be removed by filtering through diatomaceous earth using a Büchner funnel. The solutions keep for many months and are superior to starch paste or Lintner's soluble starch for use as an indicator. —B.C.I.R.A.

Starch Paste: Mechanical Liquefaction. Petit and Richard. *J. Inst. Brewing*, 1926, **32**, 281 (from *Brass. et Malt.*, 1926, **16**, 33-35).

Following on an earlier statement that soluble starch could be prepared from 2% starch paste by mechanical shaking after the addition of traces of mineral salts, it has been found possible to achieve this result by mechanical means alone. Six successive sprayings through a nebuliser under a pressure of 2 lb., or driving three times through tubes fitted internally with baffle-plates yields a soluble starch passing through filter paper and with a specific rotatory power of +210°, the viscosity having decreased to $\frac{1}{25}$ its original value. If this solution is preserved by the addition of toluene or by sterilisation at 100° C., the slight initial cloudiness increases and a deposit, consisting of starch and cellulose fibres, separates in about six months. In cases where the solution is perfectly clear at the start, it remains unaltered during this period. Whereas during diastatic hydrolysis of starch paste very little deposit is formed, similar treatment of a paste liquefied as above results in the separation of a heavy precipitate. Details are given of an examination of this precipitate, indicating that it is an intimate mixture of starch and cellulose. Further investigations show that starch flour that has been treated with petroleum ether gives a paste of very low viscosity. —B.C.I.R.A.

Starch: Constitution. J. C. Irvine and J. Macdonald. *J. Chem. Soc.*, 1926, 1502-1518.

Exhaustive methylation of starch indicated three distinct stages yielding three products of constant composition and properties. These are designated (I.) dimethyl starch, with 32% methoxyl, (II.) methylated starch, 36·3% methoxyl, and (III.) trimethyl starch, 43·7% methoxyl. On hydrolysis with methyl alcohol and hydrogen chloride, II. and III. yielded 2 : 3 : 6-tri-methyl methylglucoside of melting point 57·5°. No trace could be found of the 2 : 3 : 4 product (derived from maltose). The results are in agreement with those arrived at in recent studies of enzyme action. The alternative possible disaccharides based on the 2 : 3 : 6 trimethyl glucose unit are discussed.
—B.C.I.R.A.

Gelatin: Swelling and Osmotic Pressure. J. H. Northrop and M. Kunitz. *J. Gen. Physiol.*, 1926, **8**, 317-337.

The swelling and the osmotic pressure of gelatin at *p*H 4·7 have been measured in the presence of a number of salts. The effect of the salts on the swelling is closely paralleled by the effect on the osmotic pressure, and the bulk modulus of the gelatin particles calculated from these figures is constant up to an increase in volume of 800%. As soon as swelling is increased by any salt beyond this point, the bulk modulus decreases. This is interpreted as showing that the elastic limit has been exceeded. Gelatin swollen in acid returns to its original volume after removal of the acid, while gelatin swollen in salt solution does not do so. This is to be expected if the elastic limit (above) is exceeded. The modulus of elasticity of gelatin swollen in salt solutions varies in the same way as the bulk modulus calculated from the osmotic pressure and the swelling. The increase in osmotic pressure caused by the salt is reversible on removal of the salt. The observed osmotic pressure is much greater than the osmotic pressure calculated from the Donnan equilibrium except in the case of aluminium chloride where the calculated and observed pressures agree closely. The increase in swelling in salt solutions is due to an increase in osmotic pressure. This increase is probably due to a change in the osmotic pressure of the gelatin itself rather than to a difference in ion concentration. —B.C.I.R.A.

Stressed Gelatin: X-ray Fibre Structure. (1) J. R. Katz. (2) O. Gerngross and J. R. Katz. *Kolloid. Z.*, 1926, **39**, 180-183.

(1) Following the work in which an analogy between the X-ray diagrams of stressed gelatin and fibrous collagen is demonstrated, the authors looked for evidence of fibrillar structure in gelatin which had been more highly stressed. Such stressed

gelatin after drying *in vacuo* over sulphuric acid showed, often without mechanical treatment, fissures in the direction of stress. When a strip of such gelatin after long drying was struck sharply with a hammer it broke into splinters which were fibrous and recalled asbestos fibres. It is pointed out that although a necessary condition of fibre structure is the ability to split along the length axis the converse is not necessarily proof of fibrillar structure.

(2) The method used by the authors in making glycerin-gelatin gels capable of sustaining very high stresses is described. With improved technique in stressing, the similarity between the X-ray diagrams of stressed gelatin and sinew collagen is further emphasised. —B.C.I.R.A.

Stressed Gelatin: X-ray Diagrams. J. R. Katz and O. Gerngross. *Chem. Abs.*, 1926, **20**, 528 (from *Natur-wiss.*, 1925, **13**, 900-903).

In the X-ray diffraction spectrum obtained from dry gelatin films, prepared with and without mechanical stress, the diffuse ring and the wide, sharp ring occurring in the unstressed material (periods of identity 4 and 2·7 Å.u. respectively) changed their appearance in stressed gelatin (100% elongation). The sharp ring dissolved into two crescent-shaped parts in the direction of the stress, two broad interference spots appeared (10 Å.u.) on both lateral sides of the central blackening, two diffuse elliptical spots at 5·5 Å.u., and no peripheral spots. This spectral diagram is in every detail analogous to that of fibrous collagen. From a theoretical standpoint this is of great importance, in that for the first time a fibre X-ray diagram has been artificially produced. Theoretical discussion is as yet withheld. —B.C.I.R.A.

Adhesives and Adhesive Action. *Engineering*, 1926, **121**, 700-701 and 737-738.

An illustrated review of the Second Report of the Adhesives Research Committee. Work on the extraction of gelatin from new sources and on its purification and standardisation is described. Details are given of the methods employed in a general investigation into adhesive action. Various types of tension and shear tests of films of adhesive between wood and between metal surfaces are described. For some films between metal surfaces the following conclusions are drawn—Thin films are stronger than thick and smooth surfaces give better joints than rough. From more general experiments is shown the benefit of applying an adhesive in two or even three stages, allowing each subsidiary film to dry before the next is applied. It is suggested that any fluid which wets a non-porous surface and then by cooling or other processes becomes a tenacious mass may be regarded as an adhesive for that surface. The various methods employed to test the tensile and shear strengths of films of glues and gelatins are described. It was found that the fracture of a glued wood joint was usually due to the breakdown of the wood, the tensile strength of the adhesive itself being greater than that of wood. —L.I.R.A.

Pectin; A Comparison of Various Methods of Obtaining Ash-free——. A. M. Emmett. *Biochem. J.*, 1926, **20**, 564-568.

The inorganic matter present in pectin may be reduced to 0·5% by electrodialysis. This method is more efficient than dialysis against distilled water or N/50 hydrochloric acid. The apparatus is described in detail. The residual 0·5% of inorganic matter is not removable by further dialysis. —L.I.R.A.

Pectin: Preparation. M. A. Griggs and R. Johnston. *J. Ind. Eng. Chem.*, 1926, **18**, 623-625.

The preparation of pure pectin from lemon albedo is described in detail. After extraction with acid the electrolytes are removed by dialysis, the pectin is precipitated by dropwise addition of alcohol, the gelatinous precipitate is flocculated by electrolysis and is filtered by suction through silk cloth. The product contains 11% moisture, 0·18% ash, has a spe ific rotation of +230 at 23° C., and is of high jellying power. The colloidal properties of the aqueous pectin solutions are described and a table of viscosities is given. The structure of the pectin gel is under investigation. —B.C.I.R.A.

Incrustations of Flax. F. Ehrlich and F. Schubert. *J. Chem. Soc.*, A., 1926, p. 547 (from *Biochem. Z.*, 1926, **169**, 13-66).

Extraction of the fibre with water at 120°-135°/2 atm. removes the pectin in a water-soluble form (hydropectin) in a yield of 16% of the dried flax. Hydropectin is a mixture of 53 parts of hexopentosan (extracted by 70% alcohol) and 45 parts of calcium magnesium pectate. The hexopentosan on hydrolysis gives a syrup containing 55% of pentoses, 17% of *d*-galactose and 20% lævulose. Further, the presence of *l*-xylose was inferred from the rotatory power of the hydrolytic products, whence the hexopentosan is supposed to be galactan - lævulosan - xylan - diaraban. Calcium magnesium pectate and free pectic acid have been examined; the former contains 3·6% of methoxyl and the latter smaller percentages of methoxyl and acetyl groups than in the corresponding product from turnips. Galacturonic acid equivalent to 56% of the pectic acid was isolated on acid hydrolysis, and *l*-arabinose, *l*-xylose, and *d*-galactose were also identified in quantities suggesting the formula $C_{46}H_{68}O_{40}$, or diacetyl-arabino-xylo-galacto-dimethoxyltetragalacturonic acid. —L.I.R.A.

α-Lignin: Constitution. E. Hägglund. *Biochem. Z.*, 1925, **158**, 350-356.

Further experimental evidence in the form of analyses of the β-naphthylamine compound of α-lignosulphonic acid, &c., is

brought forward in proof of the chemical identity of α-lignin. —B.C.I.R.A.

Lignin: Constitution. K. Freudenberg and H. Hess. *Annalen*, 1926, **448**, 121-133.

The authors formulate some reactions which serve to characterise the hydroxyl groups of primary, secondary, tertiary alcohols and phenols, and apply them to differentiating between the different hydroxyl groups of the lignin molecule. Assuming 820 as the molecular weight of lignin, they find that five hydroxyl groups react with *p*-toluene-sulphonyl chloride. Of these, less than one (0·9) is aromatic in character, the remaining 4·1 hydroxyls are aliphatic or hydroaromatic. Of these non-phenolic hydroxyls 0·6 was primary. Of 16 gram atoms of oxygen contained in 820 grams lignin, four are found in the methoxyl groups, more than four belong to aliphatic, mainly secondary or possibly to hydroaromatic hydroxyls. Approximately one is phenolic, and a half may be carbonyl oxygen. Carboxyl groups were not detected. There is no tertiary hydroxyl present. —B.C.I.R.A.

Stocking Yarns: Mechanical Properties. P. Krais. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 259-260.

A table of measurements of tensile and bursting strengths and extensibilities and other mechanical properties of artificial silk and mercerised cotton yarns used for making stockings is given. In a table comparing the relative strengths with those of loaded and unloaded silk yarns it is shown that the wearing qualities of artificial silk and mercerised cotton are higher than those of loaded silk yarns, but considerably below those of unloaded silk yarns. —B.C.I.R.A.

Textile Fabric: Tribo-electric Properties. P. E. Shaw and C. S. Jex. *Proc. Roy. Soc.*, 1926, A111, 339-355.

In observations of the charges arising by rubbing together two like solids (glass/glass) which have been rubbed or heated differently, and of the mutual friction of two like solids (glass/glass) which have been similarly rubbed or otherwise treated in a systematic way, the following definite effects have been found—(1) A glass surface starting in a standard state of purity adsorbs condensible material if left in the air and its coefficient of friction (μ) *slowly* descends in several days from a value 1·2 to about 0·7. (2) Ordinary textiles rubbed on the standard glass bring about the lowering of μ *quickly*. For a value of $\mu=0{\cdot}18$ the charge on the glass due to rubbing becomes positive, having been negative for higher values of μ. (3) Textile materials, rendered clean by prolonged extraction in a Soxhlet slowly reduce μ for the glass to about 0·6 as the limit. The charge on the glass remains negative. (4) When glass has medium values of μ the sign of the charge due to rubbing can be made + or — according as rubbing is gentle or violent, and when yarns and fabrics are used, according as rubbing is along or across the fibre. (5) Two standard glass surfaces acquire no charges when rubbed together, but if one has been rubbed by a textile more than the other it is positive to the other. —B.C.I.R.A.

Fenchel Paper "Water-extensibility" Tester. K. Fenchel. *Papier-Fabr.* (Fest.-u. Ausland-Heft), 1926, 98-103.

An instrument constructed by the Schopper firm for testing the extensibility of paper in the wet state is described in which the extension of a wet strip of paper is measured under the constant conditions following—(1) An immersion of the strip for one minute in distilled water at room temperature and the extension reading taken after an interval of three minutes; (2) the load to be half the weight per square metre of the paper under test and to be applied before immersing the strip; (3) the test strip to be taken from the middle of the paper width. The so obtained extension value is termed the "water extensibility." The "moisture extensibility" will be dealt with in a later communication. —B.C.I.R.A.

Writing Paper: Tensile Testing. S. Kohler and G. Hall. *Chem. Abs.*, 1926, **20**, 987-988 (from *World's Paper Trade Review*, 1926, **84**, 1610-1614; *Paper Makers' Monthly J.*, 1926, **63**, 419-421; and *Paper Mill*, 1925, **49**, No. 50, 14, 16).

Tests made at the Swedish Government Testing Institute show that—(1) The tensile strength is increased and the elongation decreased on increasing the speed at which the Schopper tester is run; (2) no difference in folding resistance is observed on running the machine at 80 and 110 double folds a minute, and an increase of about 5% on running it at 140 double folds a minute; (3) better agreement is obtained in the determination of tensile strength than in determining folding resistance; (4) under the action of light the folding resistance of paper made from bleached sulphite pulp decreased much more rapidly than that of unbleached or bleached cotton or linen rag paper; (5) increase in the copper number of the fibre material probably reduces the durability of the paper; (6) rosin sizing causes a decrease in the folding resistance. The effects of different sizing and loading on durability are given. —B.C.I.R.A.

Mullen Tester: Application. K. Fenchel. *Papier-fabrikant* (Verein Zellstoff Ingenieure Section), 1926, **24**, 294-295.

The bursting test affords the best method of judging the strength properties of paper, but the results must be expressed in a form which is independent of the weight per sq. metre of the paper. The author proposes for the comparison of different papers

tested on the same machine a factor which he calls the relative bursting pressure which is the observed bursting pressure reduced to a weight per sq. metre of 100 grams. A table is reproduced showing, for the apparatus used by the author, the relation between relative and absolute bursting pressures for papers having weights per sq. metre between 50 and 160 grams. —B.C.I.R.A.

Paraguay Cotton: Spinning Test. T. Bühler. *Leipziger Monats. Text. Ind.*, 1926, **41**, 161-163.

Climatic conditions in Paraguay are almost as favourable for cotton cultivation as those in a large part of the cotton belt of the United States. The results of a spinning test on Paraguay "Primera" cotton are given. According to the staple diagrams 52% of this cotton is between 25 and 30 mm. staple, and 30% between 20 and 25 mm. The cotton was spun to the same counts as American strict middling of 28-30 mm. staple. —B.C.I.R.A.

Chinese Cotton: Spinning Tests. *Textielind.*, 1925, **6**, 67-71.

Spinning tests on acclimatised "Trice" and "Acala" cottons and the improved native type known as "Million Dollar" are reported. The Trice cotton was clean and free from sand, leaf, seed, and water; the blow room loss was 6·8% as against 8·5% for Middling American. The breaking load of 20's warp was about 70-75 lb., between those of G.M. and F.M. American. The Acala gave even better results, a 2/42 yarn was stronger than G.M. American, showing that the cotton is suitable for fine counts. Compared with ordinary mixing the Acala appears to possess greater strength for less weight; the fine convolutions which characterise this variety facilitate spinning which accordingly requires less working time. The yarn is very supple and lustrous. Contrary to the opinion generally held of Chinese cotton, it is possible to spin successfully from the "Million Dollar" variety 36 and 42's yarns, and 32's yarn can be spun profitably commercially. The appearance is undoubtedly better than that of American yarns and the whiteness, evenness, and lustre of the fabric are striking. Statistics for the years 1923 and 1924 are given in the article in respect of the number of spindles in Chinese mills, Chinese production, imports, exports and consumption of raw cotton, hours of wages and conditions of work in the Chinese mills. In 1924 only 17% of the cotton sent to the Cotton Testing House was passed as standard (as compared with 31 and 40% in the two preceding years). The measures taken in the various provinces to repress illicit practices (mainly weighting cotton with water) are described, and consist in free seed distribution and establishment of test houses. —B.C.I.R.A.

Tests for the Fastness of Dyestuffs on Wool; A Proposed System of——. H. R. Hirst. *J. Soc. Dyers and Col.*, 1925, **41**, 347-354.

Gives in detail methods which have been adopted for testing the fastness of dyestuffs on wool. The standards recommended by the German Commission on Fastness of Dyes (1914) have been used with certain modifications. A bibliography is appended. —L.I.R.A.

Absorbent Cotton: Testing. M. Francois and F. Richard. *Chem. Abs.*, 1926, **20**, 1303 (from *J. pharm. chim.*, 1925, **2**, 273-280).

A review of several standard methods indicates the need for an assay method for absorbent cotton. A well-defined immersion test should be given in the Pharmacopœia Codex, allowing a maximum of 10 secs. for the time of complete wetting. The fat content, to be determined by extraction with ethyl alcohol, should not exceed 0·20 gram per 100 grams of cotton, and tests for ash and neutrality should be given. —B.C.I.R.A.

Absorbent Cotton: Testing. Alfredo and Pagniello. *Chem. Abstr.*, 1925, **19**, 3349 (from *Giorn. farm. chim.*, 1925, **74**, 153-158).

The Italian army medical service test for absorbent power gives lower results than the usual immersion test but claims to be exact. The absorbent power is reduced in strongly twined fibres and is sometimes completely destroyed by sterilisation. —B.C.I.R.A.

Elasticity. A. Schob. *Chem. Abstr.*, 1926, **20**, 684 (from *Gummi-Ztg.*, 1925, **40**, 624-625).

It is proposed to define elasticity as the ratio : work recovered/work expended, when a material is subjected to deformation. For complete elasticity the ratio is 1 and for complete plasticity it is 0. Neither limit is, however, reached by any material. This definition does not involve the extent of the deformation, the latter depending merely on the specific resistance against deformation. Deformation thus presupposes elasticity but is not a measure of it. On this basis rubber is a relatively inelastic material, compared, for example, with steel. Elasticity as thus defined can be measured directly by the relative height or rebound of a falling body. —B.C.I.R.A.

Colorimetry. C. Schæfer. *Physikal. Z.*, 1926, **27**, 347-353.

The author tested Ostwald's view that the addition of black to a pigment alters its shade (other authorities have assumed that only darkening occurs). By measuring the relative brightness of a yellow (and green) pigment alone and mixed with 25%, 50%, and 75% of black pigment, decreases in relative brightness of approximately 25%, 50%, and 75% were obtained.

These differences could be compensated by suitable illumination. The conclusion is drawn that admixture of black effects only a darkening. By a theoretical treatment of light remission powers of pigments—Ostwald's black and white correspond to maxima and minima on the remission curves—the author shows that it is impossible to characterise a definite colour tone by its content of black and white alone, and that a further factor, namely, the width of the remission region must be taken into consideration. —B.C.I.R.A.

White Paper: Colour Measurement; and the Pfund Colorimeter. R. E. Lofton. *Technologic Papers, Bur. Standards*, 1923, **17**, 667-676.

The colour characteristics of 21 commercial white papers have been measured using the Pfund colorimeter in which the principle of multiple reflections is employed. Light from a 100 watt incandescent lamp falls on the larger of two discs of the paper to be investigated and is reflected between the two discs and finally up through a circular aperture in the smaller disc to an optical cube by which it is reflected horizontally into an eyepiece. Simultaneously a beam of light from the source is reflected by a roughly ground glass disc along a tube, through the optical cube and into the eyepiece. The field of view through the eyepiece is divided horizontally and the lower half is lighted by diffuse reflection from the samples. A lever arm and pointer are connected with the horizontal axis of the mirror, and by means of the lever arm the ground glass mirror can be rotated about its horizontal axis so as to direct any proportion of its total reflection along the tube to the eyepiece. The pointer moves along an arbitrary scale which has been graduated in terms of light intensities. The examination of the paper is made by matching the two halves of the field as they appear when viewed through each of three coloured glasses placed at a given point in the eyepiece tube. A graph furnished with the colorimeter may be used to convert the scale readings found to coefficients of diffuse reflection. None of the papers tested was found to be truly white. —B.C.I.R.A.

Eastman Colorimeter: Application. W. Brecht. *Papier-Fabr.* (Fest-u. Ausland Heft), 1926, 72-86.

The results of researches concerned with the numerical determination of fastness to light of papers, indicate that the Eastman colorimeter can be adapted to this purpose in a satisfactory way. Three papers of optically different colour-appearance were tested for their colour composition before and after being subjected to the action of standard artificial radiation from an electric light source. The change in the separate component constituents was expressed as a percentage and represent a criterion indirectly proportional to the fastness to light. It was found necessary to take into account errors specific to the observer and the paper colour tested. The researches communicated form the beginning of a systematic investigation which aims at explaining the effect of different fibre substances and different sizes, dyestuffs and loading materials on the fastness to light of papers. —B.C.I.R.A.

"Guild" Trichromatic Colorimeter. J. Guild. *J. Sci. Instr.*, 1926, **3**, 273.

In this instrument, which is designed for standardisation work as well as for ordinary test purposes, the primaries are obtained by dyed gelatin filters giving saturated red, green, and blue colours respectively. The filters are mounted in three annular windows while a periscopic prism, revolving rapidly about the centre of one of its apertures, combines the three colours by persistence of vision. The outer end of this prism passes immediately behind each filter and so transmits the light from each to the centre of the optical system and the field of view. Sectorial shutters in front of the annular windows control the relative amounts of the three primaries in the mixture. Provision is made for measuring saturated colours by a dilution method. The results can readily be transferred from the arbitrary primaries of the instrument to any fundamental set of primaries, or can be expressed in terms of hue and saturation if desired. —B.C.I.R.A.

Heterochromatic Photometry. C. Schaefer. *Physikal. Z.*, 1925, **26**, 58-64 and 908-913.

The author has made photometric measurements, step by step, round a complete colour cycle, such as the Ostwald colour atlas, using (*a*) a direct comparison, and (*b*) a flicker photometer, in order to determine whether the commutative law is valid for these two methods of heterochromatic photometry. He finds that if too few steps are taken the individual comparisons become inexact owing to the large colour differences involved; if on the other hand the steps are small, the accumulated error at the end of the cycle is large. With 12 steps he finds that both systems are valid to about 3 or 4% and this must be regarded as within the experimental error. By further work reported subsequently the validity of heterochromatic photometry was confirmed. —B.C.I.R.A.

Dyestuffs: Light Sensitivity. G. Kögel and A. Steigmann. *Kolloid-Z.*, 1926, **39**, 52-56.

It is possible to detect latent light impressions in Methylene Blue in the presence of gelatin (or cellulose) as dye substrate. An exposure to light of 1-2 seconds is sufficient to make a silver-free Methylene Blue-gelatin paper developable. Methylene Blue yields, on the shortest exposure, with strictly yellow, red, blue, or green filters, a reduction product which reduces silver

nitrate and even silver chloride to "nuclear" silver. If therefore the exposed panchromatic Methylene Blue-gelatin paper has poured over it a silver nitrate solution (1 : 100), there results in the exposed parts of the Methylene Blue gelatin (with any filter but least with green), silver nuclei on which image-forming silver precipitates on subsequent physical development with alkali-free metol-sulphite (and silver nitrate which is already present in the film). The panchromatism of the Methylene Blue, specially its red- and green-sensitivity is so extraordinarily well marked that the paper is suitable for meteorological and physiological light measurements. Quinonediazide - gelatin papers can be prepared and developed in the same way, and other dyes which have been found to act similarly are dicyanine, orthochrome-T, eosin, erythrosin, rhodamine B, thioflavine-T, flavinduline and phenosafranine. —B.C.I.R.A.

Emulsification. A. J. Stamm and E. O. Kraemer. *J. Phys. Chem.*, 1926, **30**, 992-1000.

A survey of recent studies of emulsions shows that much of the original evidence for the "oriented wedge" theory of emulsions has not been confirmed and that the consequences predicted by the theory have not materialised. It is suggested that insufficient attention has been paid to the mechanism of emulsion formation. The formation of an emulsion by shaking, mixing, &c., may be safely considered as consisting of two stages—(1) A pulverisation of both phases into lamellæ and drops, and (2) a coagulation or reunion of the drops of one or both phases. The degree of dispersion and the phase relations of an emulsion are the net results of these two opposing processes. The function of an "emulsifying agent" is to protect, more or less, the drops of *one* phase already formed in the pulverising stage from coagulating, whilst allowing the drops of the other phase to coagulate to give the dispersion medium. The protecting or stabilising action probably depends on the formation of a film at the interface. Although the character of such a stabilising film is incompletely understood, it seems unlikely that the molecules in the film can determine the film properties by virtue of their geometrical size and shape, as suggested in the oriented wedge theory. Examples are given to demonstrate the complexity of the mechanism of emulsion formation. —B.C.I.R.A.

Fats and Oils: Iodine Values. B. M. Margosches and K. Fuchs. *Ber.*, 1926, **59**, 375-376.

The difference between the per-iodine number and the iodine number is suggested as a convenient constant for fats. Iodine numbers, per-iodine numbers, and "difference iodine numbers" are tabulated for a number of oils, including cotton seed oil. —B.C.I.R.A.

Mineral Oils: Autoxidation of, and Determination of the Tar Value. J. Marcusson and W. Bauerschafer. *J. Soc. Chem. Ind.*, B., 1926, p. 427 (from *Chem Ztg.*, 1926, **50**, 263-264).

The acids produced in the sludge test of mineral oils have been examined. Those from a normal, unrefined transformer oil (d^{20} 0·891, open flash pt. 154°, acid value nil, tar value 0·88, ash 0·015%, viscosity at 20° 3·09) had a greater density than 1 and the copper salts were completely soluble in benzine. Treatment with benzine caused a separation into 60% of soluble oily acids and 40% of insoluble, asphaltic acids. The soluble acids had acid value 66, saponif. value 130, acetyl value 58, iodine value 16, mean molecular weight (Rast) 285. No reaction was given in the formolite test. The insoluble acids had acid value 67, saponif. value 269, acetyl value 127, iodine value 18. It is concluded that the soluble acids consist of hydroxynapthenic acids formed from saturated naphthenes and that the insoluble acids are produced from unsaturated hydrocarbons by union of two molecules and the addition of oxygen. Of the acids from a refined white oil (d^{20} 0·842, open flash pt. 181°, free acid nil, sulphur 0·015%, tar value 14·5, viscosity at 20° (3·98), 90% were soluble in benzine and this fraction had d 1·014, acid value 121, saponif. value 240, acetyl value 44, iodine value 16, mean molecular weight 357, and gave a negative formolite reaction. The copper salts were soluble in benzine and the peroxide content was very slight, the amount of active oxygen present being 0·06%. A modified sludge test is described, wherein, by the use of sodium hydroxide as catalyst, a saving in time and oxygen is effected. Fifty g. of the oil are mixed with 10 g. of pumice saturated with sodium hydroxide (prepared by addition of the pumice to 0·7 g. of sodium hydroxide in 10 c.c. of water and drying at 105°) in a 200 c.c. conical flask and heated at 120° for 24 hours. The mixture is cooled, 50 c.c. of 50% alcoholic sodium hydroxide (containing 7·5% NaOH) are added, and the liquid is heated under a reflux condenser for 25 minutes. The soap solution is separated, acidified, and extracted with benzene. From the extract, after removal of mineral acid by washing, the tarry matter is obtained by evaporation. This method with refined transformer oils, gives results differing by only a few hundredths of 1% from those obtained by the standard German method. —L.I.R.A.

Distinguishing Indigo from Indanthrene Blue. C. F. Green. *Text. Colorist*, 1926, **48**, 615.

Dyed fabric is spotted with a solution containing 10 g. of stannous chloride, 50 c.c. of hydrochloric acid and 50 c.c. of water; either dye is discharged, but that of Indanthrene Blue returns whereas Indigo does not. —A.J.H.

7—BUILDING AND POWER

(C)—Power

Springs: Design. (1) T. McLean Jasper. (2) W. G. Brombacher. *Mech. Eng.*, 1926, **48**, 487-494.

(1) The paper deals with the design of steel springs to be used for shock-absorbing and for recuperating machinery. Experimental results of tensile strength and other tests on a 1·02% carbon steel quenched at various temperatures are given.

(2) The paper gives the results obtained in a study of the design and properties of phosphor-bronze helical springs for precision instruments. The spring testing apparatus is described.

(3) A report of the discussion on the above two papers. —B.C.I.R.A.

Purifying Steam. *J. Soc. Dyers and Col.*, 1926, **42**, p. 162.

A new development in connection with boiler plant, the automatic drying and purification of the steam inside the boiler itself, is of particular interest to dyers and bleachers. There are normally present in the steam, particles of iron rust from boilers, pipes and tanks, as well as mineral dust, chiefly scale, which is deposited in the boiler, even with a water of 5° hardness, together with 2-5% of free moisture particles in the form of a mist carried over mechanically. Absolutely clean steam is very important in dyeing operations, and a new separator and dryer known as the "Atlas" made by the Power Auxiliaries Co. Ltd., of Manchester, claims to remove all the solid impurities and reduce the moisture content to less than 0·5%. The apparatus consists of a longitudinal light cast-iron box, inside the boiler, attached to the bottom of the steam outlet pipe. The steam enters through the sides of the box, which is built up of a large number of narrow gutter baffles with a narrow slit space between, arranged in rows close together, one behind the other, the slits in each row being staggered relatively to the next row. In this way the steam is split up into hundreds of narrow streams (the total area of which, however, is greater than the boiler outlet pipe) which are forced to take a rapid zig-zag course, during which all the water particles and the impurities are left behind. These run down to the bottom of the boxes, and are discharged by a pipe through the front of the boiler. —L.I.R.A.

Zeolite Water Softening. F. B. Beech. *J. Chem. Soc.*, 1926, B., p. 468 (from *Eng. and Cont. Water Works, Issue*, 1925, **64**, p. 1051-4).

Experiences with a zeolite water-softening plant for treating boiler feed water are outlined. The saving in fuel consumption and boiler maintenance effected during the first ten months of working was sufficient to pay the cost of the softening plant. The base-exchange compound used is glauconite (greensand), a hydrous silicate of iron, aluminium, and potassium, and after 20 months' use the only important change detectable in the material was an increase in the manganese content from 0 to 0·28%. Approximately ⅛ lb. of sodium chloride is required for regeneration per 1,000 grains of hardness removed. The plant will remove manganese and *Crenothrix*, rendering the water suitable for laundry purposes, &c. There is little difference in the cost of softening by this method and by the lime soda process. —L.I.R.A.

(F)—Lighting

Lighting of Silk Mills. W. J. Jones. *Silk J.*, 1926, **2**, No. 21, p. 62.

Photographs are given showing old-fashioned and scientific lighting of the same weaving shed. The figures given prove that 15% greater production may be obtained at a trifling increase of cost for lighting. Old style of drop pendants supply patches of intense light amid comparative darkness, while the new system of grouped lamps produce an effect resembling daylight in character and uniformity, at the same time saving wiring, giving greater power efficiency and involving less breakage of lamps. Details of lighting arrangements should be carefully adjusted to the requirements of the room. —F.G.P.

Lamplough Daylight Unit. F. E. Lamplough. *J. Soc. Dyers and Col.*, 1926, **42**, 110.

The unit contains six 200 or three 500 watt lamps and gives a good and even illumination. Reference is made to the "shot" effect due to the "yellow spot" of the retina, which causes pairs of fabrics which match when examined near the eyes to appear totally out of match when seen at a little distance. —B.C.I.R.A.

Electric Lamp Photoelectric Control Apparatus. J. Kunz and V. E. Shelford. *J. Optical Soc. America*, 1926, **12**, 693-696.

Equipment for controlling artificial lights so that they are turned on when sunlight is obscured and off when it is available comprises a Kunz photoelectric cell, a galvanometer relay, a pneumatic valve and a pneumatic electric switch. Diagrams are given showing the arrangement of the apparatus which renders possible the automatic control of factory lights, &c. —B.C.I.R.A.

Lighting. F. Benford. *Gen. Elec. Rev.*, 1925, **28**, 707-713.

Some notes on light and vision, including a discussion of some types of glare and other causes of eye fatigue and a brief treatment of the merits of direct, indirect, and semi-direct lighting. —B.C.I.R.A.

(G)—Heating

Heating and Ventilating Installations: Modern, in the Textile Industry. G. Schmidt. *Leipziger Monats. Text. Ind.*, 1926, **41**, 267-269.

Temperatures are given for points at various heights above the floor of a shed and the system of ventilating by using the greater buoyancy of the warmer air is shown to waste a considerable amount of heat. It is pointed out that long hot air conduits made of metal also give large heat losses. A system is described in which machines designed to heat and circulate the air are installed in the places in which hot air is needed. The supply of heat is provided by steam or hot water pipes and each heating unit can be turned off when not required. The system is claimed to be very economical and is easily installed. It can be used also to cool the air in warm weather, thereby reducing the supply of moisture necessary to give suitable working conditions. —L.I.R.A.

(H)—Humidification

"Vortex" Humidifier. J. W. Graham. *Text. Rec.*, 1926, **44**, No. 518, 80-83.

A lecture on humidification in the cotton cloth factory, dealing with the effect of artificial humidification on the cotton, on the operatives and on the standing charges of the mill, and with special reference to the Vortex system of humidification. This consists of a series of cylinders connected together and to a pump by suitable feed and return pipings. The pump draws water from a tank which is, in turn, supplied from the drinking water service. In the upper part of each cylinder is a jet with a nozzle of $\frac{1}{16}$ in. diameter from which is pumped $1\frac{1}{4}$ gallons of water per minute. On leaving the orifice the stream of water impinges on the flat head of a toughened nickel pin which breaks it up into the shape of a constantly onrushing hollow cone of water. As this speedily fills the body of the machine it establishes a partial vacuum sufficiently powerful to induce a current of 1,000 cu. ft. of air per minute to enter the machine. During its passage through the water spray the air is humidified, heated, or cooled by the use of hot or cold water, and thoroughly cleansed of dust and dirt particles. —B.C.I.R.A.

Hygrometers. *Text. Merc.*, 1926, **74**, 479.

A general account of methods of measuring humidity in the textile industry. —B.C.I.R.A.

Recording Hygrometer. L. Behr. *J. Optical Soc. America*, 1926, **12**, 623-653.

From the formula for relative humidity in terms of wet and dry bulb temperatures, it is shown that for constant humidity the relation between the temperatures is very nearly a linear one, and that the value of the humidity is defined by the ratio (wet bulb temperature —A) / (dry bulb temperature —B) where B is a constant and A is a function of the relative humidity but changes only slightly with it. By using a nickel resistance thermometer in a network which is essentially a split circuit potentiometer, it is possible to secure a potential difference across the ends of a slide wire which is directly proportional to the denominator of the ratio. In a similar circuit a potential difference is obtained which is proportional to the numerator. The latter potential difference is automatically balanced against a portion of the former by recorder mechanism and the position of balance indicates the ratio, so that the instrument reads directly in relative humidity. The recorder mechanism is capable of automatically balancing any network of impedances where the balance point is attained by the motion of one or more sliders along slide wires and where the balance point is determined by the absence of current in the recorder galvanometer. Two forms of wet bulb are described which are capable of continuous operation. In one, the customary wick is replaced by a spray and in the other a long wick is provided so that a clean portion can be substituted for the soiled part merely by turning a roller to wind the wick from one holder to another. —B.C.I.R.A.

(I)—Ventilation

Ventilation in Weaving Sheds. *Text. Mf.*, 1926, **52**, 218.

An account is given of experiments carried out by the Industrial Fatigue Research Board to observe the effect of fan ventilation in a weaving shed and also to determine at what values of temperature and relative humidity the output reaches a maximum. The output when the fans were running, was found to increase by 1·6% in the morning spell and 2·9% in the afternoon spell. The beneficial effect of the fans was most marked when the temperature and relative humidity were high. The value of the relative humidity at which the number of warp breakages was a minimum was found to be 87·5%, while the value for maximum output was between 75 and 80%, thus showing that high relative humidity reduces the efficiency of the weaver. The temperature for maximum output was between 72·5° and 75° F. The investigation shows that very high temperature and humidities are undesirable and that the output is increased by efficient ventilation. —L.I.R.A.

Ventilation Installations; Textile——. See Section 7G.

8—DESIGN

The Mutochrome and its Application to the Coloration of Design in Industry. A. B. Klein. *J. Soc. Dyers and Col.*, 1926, **42**, 121-124.

The purpose of the Mutochrome is to enable any given design or pattern to be

studied in an infinite variety of colour combinations with the minimum expenditure of time and effort. Briefly stated, the method adopted is to produce on different portions of the same photographic plate a series of transparencies each of which corresponds to one element of the design. These images are then projected on to a screen through separate lenses in such a way as to "mesh" accurately. Any individual element can then be coloured in any desired manner by the insertion of a colour filter in front of the corresponding lens, the adjustment of an iris diaphragm controlling the brightness or "depth" of the colour. The Mutochrome is used both for making the transparencies and for projection—a procedure which not only simplifies the preliminary operations, but also gives a perfect solution of the problem of registration. Having once obtained the transparencies for the elements of any design, an infinite number of colour combinations and gradations can be tried with the utmost speed. If the screen is covered by material of the texture which is actually to be used, the precise appearance of the coloured fabric will be seen. —L.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Silk Hosiery in the Magazines. *Silk J.*, 1926, **2**, No. 21, p. 66.

It is said that American women (numbering about 40½ millions) use annually nearly 625 million pairs of stockings, 40% of which are silk, at a cost of 345 million dollars. Both hosiery and underwear makers are using increasing quantities of rayon. —F.G.P.

Silk in Czecho-Slovakia. *Silk J.*, 1926, **2**, No. 20, p. 72.

Ribbons are produced as a domestic industry, other goods in the mills. There are about 12,500 looms weaving silks, plushes, velvets, satins, and unions. The umbrella and tie silks have a world-wide fame and costly art fabrics for clerical vestments and upholstery are made. —F.G.P.

Cotton: Production Statistics. J. A. Todd. *Emp. Cotton Grow. Rev.*, 1926, **3**, 280-284.

The 1925 crop of American cotton amounted to 57% of the world production of all staples, and to 80% of the world production of medium staples. The acreage, crop, and yield per acre figures by varieties for each year since 1915-16 are given. In 1925-26 the Indian staples ⅞ in. and over averaged 93 lb. per acre, whilst poorer staples yielded only 82 lb. Empire crops for seven years and estimates for the 1925-26 year are given. —B.C.I.R.A.

Cotton Production in Colombia. *Internat. Cotton Bull.*, 1926, **4**, 325-327.

Excellent cotton but very mixed in type is grown in the Atlantico Department. Staple length varies from ⅞ in. to 1¼ in., and all of it is very strong. Nothing but perennial is grown, and the most primitive methods of picking are adopted. The branches in most cases are cut off and allowed to remain on the sandy soil for a week before the cotton is picked. Yields are about 250 lb. per acre. Classing is not performed, and adulteration of cotton in the bale is common. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (Texas). *Internat. Cotton Bull.*, 1926, **4**, 358.

High yields were achieved on small acreages of unirrigated land in connection with a competition organised by the Texas press. The winning crop yielded 16 bales on five acres of old land that had been restored to fertility by intelligent fertilisation and cultivation. The cotton was classed as strict middling $1\frac{1}{16}$ in. and was sold at 23 cents a lb. Seventeen farmers in Smith County averaged from two to three bales to the acre; and the costs of production for all the 200 entrants who farmed five acres intensively averaged only 9 cents a lb as compared with 22 cents for the whole of the State. —B.C.I.R.A.

Cotton Acreage in U.S.A. *Internat. Cotton Bull.*, 1926, **4**, 359, 361.

A table gives the value of October contracts in both January and March from 1914 to 1926, together with the acreages planted each year. This table is useful in view of the contention of many members of the cotton trade that the price of cotton is not a factor of importance in determining the acreages. They consider that the farmers have no alternative "money crop" and are therefore compelled to concentrate on cotton irrespective of the remuneration offered. The leaders of the American Cotton Association admit the failure of their attempts to restrict the 1926 acreage, preparations for planting having exceeded the acreage for the 1925 crop. The response to the appeal in Texas was particularly small. —B.C.I.R.A.

Cotton in U.S.A. (Oklahoma): Co-operative Marketing. *Internat. Cotton Bull.*, 1926, **4**, 363-365.

The costs of handling cotton by the Oklahoma Cotton Growers' Association during the last four years are analysed. A comparison of street prices with those paid to members shows a gain of 7·15 dollars a bale in 1921-22, 19·58 dollars in 1922-23, a loss of 5·99 dollars in 1923-24 and a gain of 6·51 dollars in 1924-25. From evidence in the trade it is now apparent that the association has influenced the entire industry and street buyers are now operating on a smaller margin than before the organisation was established. —B.C.I.R.A.

Cotton Production in U.S.A. (S. California). *Internat. Cotton Bull.*, 1926, **4**, 365-369 (from the *Mercantile Trust Review of the Pacific*, October, 1925).

The progress of cotton growing in S. California since 1920 is described at length, and a table gives the area under cotton and the yields per acre for the past five years in the San Joaquin Valley, Imperial Valley, and Riverside countries and in the Mexican Imperial Valley. San Joaquin with an average yield of nearly a bale to the acre and an increase from 37,250 acres in 1924 to 91,100 in 1925 shows the greatest progress. —B.C.I.R.A.

Cotton: World Production. *Internat. Cotton Bull.*, 1926, **4**, 376.

The Bureau of Agricultural Economics of the United States Department of Agriculture estimates the world's cotton crop for the 1925-26 season at 27,800,000 bales of 478 lb. net excluding linters, which compares with 24,800,000 bales last season. The U.S.A., Egypt, Sudan, Russia, and Turkey showed increases, the Indian crop remained the same, and slight decreases are reported from Mexico, China, and Peru. Figures for both seasons are given country by country. —B.C.I.R.A.

Cotton Production in Argentina. *Internat. Cotton Bull.*, 1926, **4**, 376.

The crop in 1924-25 suffered from drought and pests and the yields were reduced to 400 lb. seed cotton per acre. An increase in the area under cotton from 104,513 hectares to 110,335 hectares for the 1925-26 crop is however reported. Of the latter area 89% lies in the Chaco Territory. —B.C.I.R.A.

Cotton Production in the Belgian Congo. *Internat. Cotton Bull.*, 1926, **4**, 378.

Cotton to the amount of 6,000 to 7,000 tons will be grown in the north-east of the Belgian Congo—the Uelle district—this year; and cotton raising companies in the whole colony expect to grow between 20,000 and 40,000 tons annually by 1930. Twenty-two ginning stations are in course of erection and orders have been placed for the plant for 13 more. These are in addition to the 21 ginning stations already operating. —B.C.I.R.A.

Cotton Production in Portuguese East Africa. *Internat. Cotton Bull.*, 1926, **4**, 382.

Rapid increase in the numbers of farmers engaged in cotton growing is reported from Southern Mozambique. This area produced 713 bales from 4,470 acres in 1923-24 and a sevenfold increase in acreage was made in 1924-25. The crop for the past season, however, has been a failure owing to floods, heavy rains, and pests. Official estimates place the production at 5,000 bales for all Mozambique as compared with 10,000 bales in 1923-24. —B.C.I.R.A.

Cotton Production in Nyasaland. *Internat. Cotton Bull.*, 1926, **4**, 382.

The 1925 crop is estimated at 2,800 tons of lint, nearly three times the 1924 crop. The Port Herald district produced 1,700 tons. Owing to the appearance of pink bollworm in North Nyasa and to the restrictions placed on cotton movement from that area, cotton growing by the European planters of North Nyasa is almost prohibited, and the question of compensation has been raised. —B.C.I.R.A.

Cotton Production in Peru. *Internat. Cotton Bull.*, 1926, **4**, 392.

The 1926 crop is estimated at 185,000 bales of 500 lb., made up of the following varieties—Tanguis 157,000 bales; Suave 11,000; Mitafifi 11,000; Rough 3,000; Semi-rough 1,000; Pima, Sakel, and others 2,000 bales. A later estimate gives 194,000 bales as the total crop. —B.C.I.R.A.

Cotton Production in Russia. *Internat. Cotton Bull.*, 1926, **4**, 393.

Cotton plantings this year will amount to 1,954,000 acres, an increase of 20%. In Central Asia—the Uzbek Soviet Republic—the plantings are estimated at 1,395,000 acres, in Transcaucasia, 363,150 acres and in the Turkoman Soviet Republic 195,350 acres. —B.C.I.R.A.

Cotton Production in Salvador. *Internat. Cotton Bull.*, 1926, **4**, 393.

The crop for last season will be approximately 3,000 bales, a drop of 8,000 bales in comparison with the previous crop; and it appears certain that the crop will not figure as of any importance during 1926. Failure is ascribed to boll weevil and to other pests. —B.C.I.R.A.

Cotton Cultivation in Egypt and the Sudan. E. J. Russell. *Internat Cotton Bull.*, 1926, **4**, 394-401 (from *Geographical Teacher*).

A general account of the present condition of cotton growing along the Nile Valley. —B.C.I.R.A.

Cotton Production in Syria. *Internat. Cotton Bull.*, 1926, **4**, 401.

The 1925 yield aggregated 6,770 bales of which 90% was grown about Aleppo and is of the Baladi type. In Latakia district about 200,000 lb. were grown; about one-third was of Sakellaridis seed, and some considerable development of this variety is expected. —B.C.I.R.A.

Cotton Cultivation in the Dutch East Indies. *Textielind.*, 1924, **5**, 605-607.

The cotton of Flores (Dutch E. Indies) commands a price on European markets equal to that of good American varieties. Caravonica is the variety planted. The main cotton area consists of the eastern side of the island of Flores, the island groups

of Solor and Alor, Sawoe, Rote, the province Koepang, Amarasi, and specially the fertile plains of South Beroe. The cotton crop is an intermediate crop between the djapoeng, the main foodstuff of the natives, and the rice of the dry ground. The great difficulty in the way of extending cotton growing lies in disposing of the crop. This is complicated by the fact that the crop is not vital but merely a source of profit to the population, and accordingly the Government is trying to prevent exploitation of native growers. The history of the formation and fall of a central Amsterdam purchasing company is described and the present selling arrangement through an agreement with the directors of the old company and under Government control of prices is outlined. —B.C.I.R.A.

Cotton Cultivation in the Belgian Congo. *Textielind.*, 1925, **6**, 105-106.

An account of Belgian efforts to establish cotton growing in the Congo. American Upland types, especially "Triumph," are being acclimatised with success. The belt lies between 2° N. and 10° S. of the equator, and the best districts are Maniema, Kasai, Sankuru, and Lomani in the South, and Upper and Lower Uelé in the North. The normal yield per hectare is about 200 kilos. of ginned cotton. The Congo crop in 1921 was about 1,583 tons, in 1922, 2,593, and in 1923, 4,900 tons of raw cotton. Seed supplies and prices, conditions of sale, importation of seed and ginning operations are strictly controlled by a decree applying to all the above districts, the aim being to maintain a high quality in Congo cotton. —B.C.I.R.A.

Cotton Cultivation in India. W. H. Himbury. *Text. Merc.*, 1926, **74**, 476-478.

A report on a recent visit of inspection in India. Considerable progress has been made. A large new ginnery has been established. The work of the agricultural colleges is commended but they are understaffed. The two most important developments taking place are the Sukkur barrage and the extension of irrigation in the Punjab and Sutlej valley scheme. The Sukkur scheme should be complete by 1929 or 1930 when a million acres should be available for cotton growing. —B.C.I.R.A.

Cotton Cultivation in the Sudan. W. H. Himbury. *Text. Merc.*, 1926, **74**, 500-501.

The development of rain-grown cotton—Sakel—and to some extent American varieties—in the lower Sudan is reported on very favourably. Limiting factors are lack of cheap and efficient transport and an inadequate number of ginneries. The four new Government ginneries at Makwar are equipped with a total of 320 roller gins. Two further ginneries with saw-ginning plant will be erected shortly in the Mongalla district. —B.C.I.R.A.

Sisal Industry; Notes on the——. J. M. Wingate. *Bull. Imper. Inst.*, 1926, **24**, 49-50 (from *J. Gold Coast Agric. and Comm. Soc.*, 1925, **4**, 140).

Reference is made to the sisal hemp plantation which has been established near Accra by the Gold Coast Government. During the eight months August 1924 to March 1925, 128 tons of fibre and eight tons of tow were produced. It is estimated that the cost of bringing one acre into bearing and harvesting the leaves would amount to about £6 3s. 6d. One acre of sisal plants should yield 41 tons of leaf during its life and it is probable that the Government would be able to pay 10s. per ton for it. A profit of £14 6s. 6d. would thus be made for about 2½ months' work. The opinion is expressed that the most convenient area for a farmer to work would be nine acres, divided into three equal blocks, one of which should be planted in the first year, one in the second, and one in the third. In the fourth year the first block should be replanted and so on in regular rotation. —L.I.R.A.

Artificial Silk: Application. P. Krais. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 186-187.

Some production and consumption statistics are given, and the uses of artificial silk are briefly discussed. —B.C.I.R.A.

The Stability of Rayon. *Silk J.*, 1926, **2**, No. 21, p. 49.

Rayon is the one fibre not subject to the vagaries of nature, being under human control, consequently there will be no great fluctuations in supply and price, and any demand will surely be met. Therefore if either of the other three great textile fibres fail, as did silk at the time of the Japanese earthquake, rayon can be used partially, at any rate, to bridge the gap. The world's output is so large and its uses so distributed that any basic change is impossible, and the supply is constantly increasing, while qualities improve. Its use is firmly established in the public mind, and only its true virtues should be attributed to it. —F.G.P.

World's Rayon Output Analysed. *Amer. Silk J.*, 1926, **45**, No. 1, p. 57.

Last year's output was 25% more than 1924, and a conservative estimate puts the 1926 production at 33% more than 1925. America leads, but the outputs from Italy, England, and Germany are sufficiently near to make the race interesting. In America the Viscose Company, a subsidiary of Courtaulds, Ltd., produces as much as all the others, the production for 1926 being estimated at 40 million pounds; the estimated total is 80 millions. American rayon imports are considerable: 1,712,184 lb. for 1924, and 5,000,000 lb. for 1925. Japanese production has risen from 527,000 lb. in 1922 to 1,500,000 in 1925. Tables are given showing for 1925, America with

54,700,000 lb., Italy 30,000,000, England 28,000,000, Germany 27,100,000, France 14,400,000, Belgium 11,100,000, and the world's total 185,484,000 lb.; the estimate for 1926 being 245,000,000 lb. The uses of rayon are tabulated—21% is mixed with cotton, 18% with silk, 20% is used in hosiery and 15% in underwear. —F.G.P.

Dyehouse Economics. T. D. Buttercase. *J. Soc. Dyers and Col.*, 1926, **42**, 145-151.

The lecturer dealt with the avoidance of waste in dyehouses under the following headings—Wages, materials (dyewares, chemicals, fillings, &c.), coal and power, repairs and maintenance, miscellaneous (including damages and allowances and all standing charges, rates, insurance, &c.). The importance of having the right type of man for each particular operation and of attention to the welfare of the workers was insisted on. The relations between employers and workers and the subject of wages agreements were discussed. Considerable emphasis was laid on the importance of tracing the causes leading to the production of faulty material. In conclusion the importance of a reliable system of costing was pointed out. The lecture was followed by a discussion. —L.I.R.A.

Female Labour in Japanese Cotton Mills. *Text. Colorist*, 1926, **48**, 557 (from *India Text. J.*).

A report on the conditions in ten cotton mills employing about 84,000 females or about 60% of the total number of such employees in Japan. The report deals with age, average duration of employment, education, working hours, holidays, wages, the dormitory system, medical aid, and recreation. The employees are able to save about 70% of their income. —A.J.H.

Protection in "Color Fast" Labels. *Amer. Silk J.*, 1926, **45**, No. 1, p. 37.

In America goods are labelled "Color Fast" and "Guaranteed" but it is stated that these terms mean nothing, although wholesalers and retailers frequently exaggerate their importance. It is suggested that an association be formed to issue to members paste-on labels saying what is guaranteed and what "Fast" means, as colours fast to light may nor be fast to perspiration and laundering. Such marks attached by the dyer and finisher would have real value in ensuring the public confidence. —F.G.P.

10—MISCELLANEOUS

Hydrogenated Solvents: Properties and Application. E. H. Killheffer. *Amer. Dyestuff Rep.*, 1926, **15**, 345-350.

A general account of the preparation, properties, and industrial uses of the following solvents—"Tetralin" (tetrahydronaphthalene), "Decalin" (decahydronaphthalene), "Hexalin" (cyclohexanol), cyclohexanone, "Hexalin acetate," and "Methylhexalin." —B.C.I.R.A.

Sulphonated Oils: Properties. J. B. Crowe. *Amer. Dyestuff Rep.*, 1926, **15**, 379-382.

A general article dealing with sulphonated oils, including their manufacture, uses, analysis, and requisite properties for use in the textile industry. —B.C.I.R.A.

Zinc Chloride: Toxicity. *Chem. Abs.*, 1925, **19**, 3578 (from *Proc. Am. Wood-Preservers' Assoc.*, 1925, 18-22).

Tests have been made of the resistance of 18 species of wood-destroying fungi to zinc chloride. The order of resistance of the fungi is very different from that for sodium fluoride. Sodium fluoride is slightly more toxic than zinc chloride to two-thirds of the fungi tested. —B.C.I.R.A.

Mercury Lamp. E. O. Hulburt. *J. Optical Soc. America*, 1926, **12**, 519-520.

A simple laboratory mercury lamp is described which can be blown from pyrex or quartz tubing and in which wax seals can be employed. The form and dimensions of the tube are given. The electrodes are of iron. When exhausting, the lamp is tilted continuously to allow as much gas as possible to be drawn off. It is sealed by a stop cock. The lamp has a life of about 20 hours, but can be renewed by re-exhausting. With a current of 2 ampères its light intensity is equal to that of the small Cooper Hewitt quartz lamp. —B.C.I.R.A.

Microscope in the Textile Laboratory; Some Notes on the Use of the——. L. G. Lawrie. *J. Soc. Dyers and Col.*, 1926, **42**, 73-76.

The author briefly reviews the manifold uses to which the microscope may be put in the textile laboratory. Simple methods of cutting thin sections of textile fibres for microscopic examination are described. —L.I.R.A.

Caustic Soda Recovery Plant. A. Schrohe. *Papier-fabrikant* (Verein Zellstoff Ingenieure Section), 1926, **24**, 297-299.

A synopsis of processes described for the recovery of waste caustic soda in the manufacture of viscose and in the mercerisation of cotton. —B.C.I.R.A.

Recovery of By-products from Wool Scour Effluents. *Text. Rec.*, 1926, **44**, No. 521, 55-57.

A description of methods for recovering fatty materials. —A.J.H.

Patents

Sodium Hydroxide Recovery. L. N. Taylor, London. E.P.252,304.

Alkali may be recovered from waste liquors, obtained in the treatment of cellulose material with caustic soda, by precipitating with magnesium bicarbonate. The filtered liquor is boiled and the carbon dioxide evolved is recovered. The resulting solution of sodium carbonate may be causticised in the known manner. —B.C.I.R.A.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Silk; Novel Treatment of——. *Chemicals* (Dyestuff No.), 1926, **26**, No. 7, pp. 21-22.

Describes a treatment for reducing the ash content of silk patented by Denham and Brash and the British Silk Research Association. Silk has amphoteric properties. In pure, neutral water or in a neutral salt solution it has very feebly acidic properties and can combine with or fix mineral bases. To remove the acidic property and thus render silk unable to fix mineral bases, a small quantity of acid must be added; but if more than the requisite amount of acid is added the silk exhibits basic properties and can combine with or fix some of the acid. The acid thus fixed may not be removed readily by washing with water unless the water is alkaline; but if the alkalinity of the water is due to involatile alkali, or if it is due to a volatile alkali and the water contains mineral salts as does softened water or hard water, the silk will again fix mineral matter and its mineral content, represented by the ash, will not be the minimum attainable. Thus, although the mineral content of silk may be reduced by washing it with water containing a considerable proportion of acid, there is a danger that a deleterious proportion of acid may be left in the silk, or, on the other hand, that the mineral content may be raised again if alkali is used to neutralise the residual acid. Experiments have now shown that if silk is treated with an amount of acid not considerably in excess of that which will bring it into the isoelectric condition, the ash contents are considerably reduced and the final product is neutral or substantially neutral. This method consists in subjecting silk to the action of water containing acid in quantity sufficient to bring the silk into the isoelectric condition, separating the silk from the water with or without washing, and finally drying it. —L.I.R.A.

Supplanting of Wool by Artificial Silks. *Text. Argus*, 1926, **3**, 27th Oct., p. 4.

A discussion of such essential properties of wool as felting, waviness of individual fibres, and low heat conductivity, which any substitute for wool must have.

—A.J.H.

Wool and Acids: Constitution of Wool. H. Meyer and K. H. Finkentscher. *Melliand's Textilber.*, 1926, **7**, 605.

Wool shows no appreciable difference as regards acid dyes and simple organic or inorganic acids. The reaction towards all acids, like soluble albuminoid substances, is as a weak base, which is present as a gel and which can combine with acids to form a salt. 100g. of wool combine with about 0·08 gram equivalent of acid, entirely independent of the cross section of the wool and the kind of acids used. The equivalent weight of the wool comes to about 1,200, i.e., the wool contains about 1·1% basic nitrogen. About one-third of the basic group of the wool could be proved to be primary amines. The salts of wool are partially hydrolised on account of their slight basicity. When using about equal quantities of acids, hydrolysis follows Oswald's theory of dilution. The quantities of dyes used in practical dyeing are always fractions of the maximum that could be taken up by wool.

—B.R.A.W. & W.I.

(C)—Vegetable

Cellulosic Fibres: Ageing. C. G. Schwalbe. *Kolloid-Z.*, 1926, **39**, 178-180.

The author puts forward a plea for the use where possible of fresh material in the researches of colloid chemists into plant fibres, in order that the uncertainties introduced by "ageing" may be eliminated. Failing fresh material, he suggests the preparation of standard cotton cellulose for which the time and conditions of storage are known. —B.C.I.R.A.

Cellulose: Swelling. R. O. Herzog. *Kolloid-Z.*, 1926, **39**, 98-106.

The author deals with the known facts of swelling phenomena in cellulose in an attempt to show that the swelling of the radical lattice consists in its passing over, with maintenance of the crystallite dimensions, into an ion lattice, or the formation of such an ion lattice by ion-adsorption. Apart from the chemical binding of water, water attraction into the lattice is effected on account of the dipolarity of the lattice and, further, free-moving ions with their water sheaths are also attracted to the lattice. The direction of volume expansion of the aggregate is bound up with dissymmetry in the linkages of the crystallite. (The paper offers a useful summary of modern data.) —B.C.I.R.A.

Cellulose: Constitution; and Cellosan: Preparation. H. Pringsheim, J. Leibowitz, A. Schreiber, and E. Kasten. *Annalen*, 1926, **448**, 163-178.

Following their dissociation of lichenin into lichosan (by heating with glycerol), the authors sought to obtain a corresponding structural element of cellulose. By heating pure triacetyl-cellulose with ten times its weight of naphthalene or other high boiling solvent for 1½ hours at 235°, a glucose anhydride tri-acetate of molecular weight

288 was obtained. This substance, after saponification gave a water-soluble glucose anhydride to which the name Cellosan was given. A very rapid reassociation of a part of the saponified product was observed. The degree of dispersion of cellosan in water was dependent on the temperature; viscosity measurements were minimal at 73°-80°, and molecular weight determinations at this temperature (70-75°) showed the molecular weight of cellosan to be that of a glucose anhydride. Cellosan yielded octa-acetyl cellobiose (in the same yield as from lichenin) and hydrocellulose on acetolysis, and was converted by dialysed malt extract (which contains the lichenin-splitting enzymes lichenase and cellobiase) quantitatively to glucose. By a lichenase prepared from barley malt cellosan was synthesised to cellobiose. Unlike lichosan, cellosan is optically inactive. An aqueous solution of 0·8-3% cellosan is colloidal; at lower temperatures after two days a gel is formed which cannot be redissolved in water even at higher temperatures. The above-mentioned insoluble portion of the saponification product, which does not reduce Fehling's solution, gave the Röntgen diagram of cellulose hydrate. The authors conclude that cellulose is an association product of the glucose anhydride cellosan, which is in agreement with their theory of molecular valencies. The work affords experimental confirmation of Hess's deductions from his optical rotation curves for cellulose. —B.C.I.R.A.

Plant Fibres: Ageing. C. G. Schwalbe. *Papier-Fabr.*, 1926, **24** (Fest-u Ausland-Heft), 38-41.

The paper is a discussion of how the reaction capacity of fibres, in the state in which they are used in the cellulose and paper industries, is lessened as a result of the process of "ageing" in the living plant fibres. Two forms of fibre "ageing" are distinguished, namely, age in the sense that the wood of tree trunks is older than that of young shoots, and "age" which results when fresh green plants die and protoplasmic activity ceases. The possibility of adding hygroscopic agents such as magnesium chloride, glycerol, small quantities of acids, &c, to keep the fibres "fresh," i.e., in a condition in which their swelling and other properties are not impaired, is discussed. —B.C.I.R.A.

Cellulose: Dispersion. P. P. von Weimarn and collaborators. *Rep. Imper. Ind. Res. Inst.*, Osaka, Japan, 1925, **5**, No. 18, 208 pp., and **6**, No. 10, 79 pp.

The publication is a monograph on "dispergation" and aggregation, particularly in their application to cellulose. Fibres of various kinds of cellulose are regarded as aggregate particles consisting of minute ultramicro-crystals, probably rhombic, which are present in an axial arrangement more or less parallel to each other. The superficial layers of these crystals are probably contaminated with extraneous material, as are the ultramicro-pores of the fibres. The dispersoidological properties of the various cellulose fibres depend on: the dimensions of individual ultramicro-crystalline particles, the firmness of the bonds holding these particles together, the degree of orientation of the particles, and the nature and concentration of the impurities present in the fibre. The mechanical dispergation of different types of cellulose, and various types of colloid mill, are discussed in detail. To obtain the best results with colloid mills, cellulose should be allowed to swell in water or in salt solutions and should then be disintegrated at —80° or below. The author has shown by photo-ultramicrographs that solutions show the Brownian movement. Preliminary experiments also show that cellulose may be partially dispergated by aqueous solutions containing 0·08 mols. of sodium citrate per litre. All readily soluble salts will dispergate cellulose provided the proper conditions of temperature and pressure are maintained. Dispersoidal "parasitism" may be manifested in cellulose solutions when products of cellulose decomposition which are more readily dispersed than the unmodified cellulose act as dispergators for the cellulose particles. That these initial decomposition products are also dispersoids was shown by ultramicroscopic examination of their solutions. Two extreme types of cellulose solutions exist—(1) solutions yielding elastic continuous jellies, (2) solutions failing to produce an aggregatory effect or gradually yielding precipitates consisting of aggregate particles. These types are connected by intermediate transition forms. Type 1 is discussed very fully with special reference to process of formation, structure, and properties. Priority over Williams is again claimed for the work on thiocyanates. Earlier work on the dispergating action of sodium and barium chloride was confirmed. In the presence of a large excess of salt, intensive dispergation was noted at 180° with sodium chloride and began at a somewhat lower temperature with barium chloride. Partial hydrolysis set in and the products were amicroscopic and formed very stable solutions. Cellulose may also be dispergated by saturated solutions of lithium chloride. Two grams of cellulose were readily dispergated at 105° by 100 grams of calcium thiocyanate solution saturated at 50°, forming a pale, transparent jelly on cooling. If 8 grams of cellulose are used and the heating is continued to 125-135°, a very dark, but firm and elastic jelly is obtained on cooling. Heating above this point leads to soap-like ointments and the transition is so gradual that it is impossible to draw a line between a jelly and a semi-solid ointment. Dispersoidal solutions of cellulose containing degradation products may be formed by treating cellulose precipitates deposited from concentrated salt

solutions and washed nearly free from salts, with boiling water. The aqueous layer above the cellulose may be decanted after 42-66 hours, and the operation repeated with each cellulose residue until a number of successive "disperse systems" have been obtained. A well-defined dispergation maximum occurs in such a series at which the cellulose shows the most pronounced bluish white opalescence of any preparation of the series and the cellulose and salt concentrations are exceedingly low. Calcium thiocyanate solutions saturated at 20° and 50° were allowed to remain in contact with weighed amounts of cellulose and the mixtures were then heated at a definite temperature until complete dispergation had taken place. Time-temperature dispergation curves were constructed for solutions containing 2, 4, 5, 6, and 8 grams of pure cellulose in 100 c.cs. of solution and also for solutions containing 2 and 4 grams of sulphite pulp. The latter failed to give transparent solutions and the rate of dispergation was much slower than that of pure cellulose. The rate of dispergation increases with increasing temperature and decreases with increasing amounts of cellulose. The rate of dispergation of the cellulose depends also on the previous treatment of the sample, e.g., previous shaking lowers the temperature of complete dispergation. The velocity of dispergation of cellulose with strontium thiocyanate increases with rising temperature. If the temperature is kept constant, the velocity increases with increasing concentration of salt. Using definite volumes of solution and varying the amounts of cellulose, the rate of dispergation increased with increasing temperature and increasing salt concentration. The larger the amount of cellulose added, the longer the time required for complete dispergation. A series of photo-ultramicrographs shows the remarkable swelling of the cellulose prior to complete dispergation. Experiments on the dispergation of cellulose in aqueous strontium bromide showed that at a definite temperature the velocity of dispergation increased with concentration of the salt and also with increasing temperature, and pressure, in the strontium bromide solutions. Swelling is less marked than with strontium thiocyanate and dispergation is much slower. No complete dispergation could be obtained with strontium chloride. Cellulose was completely dispergated by barium thiocyanate solution but not by barium bromide. Only a portion entered dispersoidal solution but the fibre was broken down into particles which formed a flaky precipitate with fine-grained structure. Cellulose is readily dispergated by saturated calcium bromide solutions and photo-ultramicrographs show that the swollen cellulose fibres split into very fine fibrillæ prior to dispersion. Dispergated systems normally form translucent jellies on cooling. With 100 c.cs. of saturated calcium chloride solution at 150° in a sealed flask, 1 gram of cellulose was incompletely dispergated in 9·5 hours. The partially dispersed material failed to gelatinise. The hot disperse system on pouring into water forms unorganised agglomerated flakes. These micro-particles may be orientated in a single direction by exerting slight pressure on the cover glass of the microscope slide. The capacity for dispergating cellulose by different salts is approximately in the following descending order : Ca salts > Sr salts > Ba salts; cyanates > iodides > bromides > chlorides. The difficulties of making definite observations are emphasised and it is pointed out that whilst the dispergation capacity is in the order $CaCl_2 > BaB_2 > SrCl_2 > BaCl_2$, none of these salts produces complete dispergation. Dispersoidal solutions of cellulose in hot concentrated salt solutions, capable of geletani ing on cooling, are termed "dispersoidal solutions of the first kind." Those which are very dilute solutions of cellulose in cold salt solutions are termed "dispersoidal solutions of the second kind." A preliminary study of the latter has been made. Determinations of the amounts of cellulose dispergated by dilute aqueous solutions of sodium citrate indicate that maximum dispergation (15-17 mg. of cellulose per litre) is obtained by 0·025-0·05 millimolar sodium citrate solutions. This maximum corresponds closely to the maximum point on a curve drawn by plotting the concentration of sodium citrate against the time (in days) required for complete clearing of the disperse system. A similar study with dilute calcium chloride solutions indicated that the maximum dispergation (12-13 mg. of cellulose per litre) occurred in 0·025 millimolar calcium chloride solutions. —B.C.I.R.A.

Cellulose: X-ray Structure. O. L. Sponsler. *J. Gen. Physiol.*, 1926, **9**, 677-695.

Further deductions are made regarding the space lattice forming the wall of plant fibres (ramie especially) and assumed to be built up of elementary orthorhombic structures with the dimensions 6·10 × 5·40 × 10·30 Å.u. Further work in which it is sought to bring models constructed on the assumption that the unit groups are glucose residues into agreement with the chemical properties and diffraction patterns of cellulose will be reported later.

—B.C.I.R.A.

American Cottonseed Oil: Yield. Georgia Experiment Station. *J. Oil and Fat Ind.*, 1926, **3**, 225.

The oil content of cotton seed of a number of American varieties tested in 1924 and 1925 is given. —B.C.I.R.A.

***Gossypium* Species.** Sir G. Watt. *Bull. Misc. Information, Kew*, No. 5, 1926, 193-210.

A classified enumeration, with brief diagnostic descriptions, of certain species

of wild and cultivated cottons. The notes amplify and in some instances correct particulars given in Watt's "Wild and Cultivated Cotton Plants of the World." Attention is drawn to the importance of Africa in a study of the genus.

—B.C.I.R.A.

Acala Cotton Cultivation in China. T. S. Kuo and F. M. Chou. *Bot. Abs.*, 1926, **15**, 488 (from *Ko-Hsueh-Science-Publ. Chinese Sci. Soc.*, 1925, **10**, 366-369).

The writers give a brief history of the introduction of American cotton seed into China, and point out some of the reasons which are responsible for the failure in introducing American cotton seed, such as too much difference in climatic condition, lack of purity in seed introduced, no mass selection practised when growing, and no definite plan of acclimatisation, or of breeding. The origin of Acala seed used in this experiment is given and the cultural method and the five-year plan of acclimatisation practised are described. It is reported that Acala can be successfully acclimatised. —B.C.I.R.A.

Acala Cotton Cultivation in U.S.A. (San Joaquin Valley, California). W. B. Camp. *U.S. Dep. Agric., Dept.* Circ. No. 357, Nov., 1925, pp. 23.

Acala was substituted for Pima in 1921 and is now grown in the San Joaquin Valley to the exclusion of all other varieties. Yields have increased from ½ a bale to 1 bale per acre, and 1½ and 2 bales to the acre are common. Acala has outstanding cultural advantages and seems best able to stand adverse seasons or poor cultural conditions and still turn out a heavy yield of staple. It is early and produces large bolls, which open widely. Picking is therefore easy, an average of 250 lb. a day being attained by good pickers. The staple is uniform, measuring 1⅛ to 1$\frac{3}{16}$ in. under favourable circumstances, and at a premium of from 1 cent to 5 cents a lb. is in great demand by the manufacturers. The cultural methods that have proved well adapted to conditions in the San Joaquin Valley, including preparation of land, planting, thinning, irrigating, cultivating, &c., are described. —B.C.I.R.A.

Cotton Pests in Venezuela. A. I. Roberto. *Bot. Abs.*, 1926, **15**, 783 (*Caracas* 1925).

Alabama argillacea and possibly *Heliothis* sp. cause important damage to the cotton crop in Venezuela. The zone of maximum abundance is indicated and control measures are outlined. —B.C.I.R.A.

Cotton Plants: Effect of Handling. M. A. Bailey and J. Templeton. *Ministry Agric., Egypt, Techn. Sci. Serv.* Bull., No. 61, 7 pp.

Attention is drawn to the abnormal behaviour of cotton plants subjected to handling in the collection of daily flower production data. The plants are stunted and their foliage is darker in colour than that of the surrounding plants. The observed effects are not due to trampling of the soil but appear to be due to irritability of the plants themselves. The stunting effect is produced both by a reduction in the number of internodes and, more particularly, by a reduction in their length. The authors recommend that, where possible, routine flower counting should be carried out only every second or third day. In the earlier part of the season when flowers can be seen readily without touching the plants, observations might be carried out daily. —B.C.I.R.A.

Pink Bollworm Control in Mexico. W. Ohlendorf. *U.S. Dept. Agric.* Bull. No. 1374, 1926, 64 pp.

Studies of the pink bollworm in Mexico are described under the following headings—Distribution, hbiats, damage caused, food plants, dissemination by flight, natural control, repression. —B.C.I.R.A.

Cotton in the Sudan (Gezira): Breeding and Experiment. H. C. Jeffreys. *Wellcome Trop. Res. Lab., Khartoum, Rept. of Cotton Growing Meeting*, Sudan Gezira, Dec. 1925, pp. 7-8.

The Gezira Seed Farm will issue from 80,000 to 100,000 lb. of pure Sakel seed each year, which is sufficient to crop the whole Gezira of 100,000 feddans at the third generation. Where plants are attacked by black-arm, ammonium sulphate dressings at the rate of 175 lb. per acre are beneficial. Contrasting local seed from the previously infected crop with Egyptian, Kassala, and Tokar seed, the germination of the first is decidedly inferior; but after three months' growth the differences were not very marked. Zagora and Ashmuni varieties appeared unsatisfactory.

—B.C.I.R.A.

B. malvacearum: **Epidemiology.** R. G. Archibald. *Wellcome Trop. Res. Lab., Khartoum, Report of Cotton Growing Meeting*, Sudan Gezira, Dec. 1925, pp. 9-14.

As all Sudan seed is subjected to direct sunlight, desiccation, and high temperature treatment, and because *B. malvacearum* is extremely susceptible to these influences, infection is not carried over on the seed coat. Chemical treatment, except in assisting germination, therefore yields disappointing results. No trace of the organism has been found in the soil about affected plants, or in irrigation water. Evidence is also against insect dissemination and alternate host plants have not been found. Cultural and other experiments have, however, shown the source of infection to lie within the seed coat, and the organism has also been recovered from the plant tissues below as well as from infected parts. Unsuitable soil or climatic conditions or imperfect cultural methods lower the resistance of the plant, and improved cultivations and the application of

fertilisers, with the object of increasing the vitality of the plant, are thought the most effective counter measures. Seed from heavily infested crops of the preceding year should not be sown, though a year's storage will minimise the seed infection.
—B.C.I.R.A.

Cotton Pests in the Sudan (Gezira): Soil Conditions. H. W. Bedford. *Wellcome Trop. Res. Lab., Khartoum, Report of Cotton Growing Meeting*, Sudan Gezira, Dec. 1925, pp. 15-17.

The cotton flea beetle, the cotton stem borer, and white ants all prefer soils of open texture, friability, plentiful aeration, and warmth, and soil moisture suitable for optimum plant growth. —B.C.I.R.A.

Cotton Cultivation in the Sudan (Gezira). E. M. Crowther. *Wellcome Trop. Res. Lab., Khartoum, Rept. of Cotton Growing Meeting*, Sudan Gezira, Dec. 1925, pp. 18-29.

An account is given of the properties of the soil in the Gezira (alkaline clay) and their effects on the cotton plant. The influences of rainfall, fallow periods, and rotations on the yield of cotton are analysed.
—B.C.I.R.A.

Cotton Plant Development in the Sudan (Gezira). M. A. Bailey. *Wellcome Trop. Res. Lab., Khartoum, Report of Cotton Growing Meeting*, Sudan Gezira, Dec. 1925, pp. 29-34.

Extreme dryness, frequent pickings, and constant winds give the plant a very unproductive appearance in April, which is belied by the actual yields. The plants are more normal in the early stages, but fruiting branches are not put out until the twelfth to the fourteenth node. Contrasted with Sakel in Egypt, seven potential fruiting branches are lost and the crop is delayed by at least a fortnight. Legginess and defoliation are thought due to some other cause besides black-arm, for even plants from less affected Tokar seed also delayed flowering to the fifteenth node. Flowering curves from Egypt, the Sudan, and the West Indies are compared. They all commence to rise about 2½ months after sowing, and tend to arrive about six weeks later at a maximum and then to fall away rapidly. If the curves start late they tend to fall correspondingly late and if they rise slowly there is a tendency for them to remain high for a longer period and to fall away more gradually. The maximum rate of flower production per day in the Sudan examples is, however, very low, and this deficiency is thought due to harmful factors operating in late August and September "when humidity is quite suitable" and not to the rapid fall in relative humidity in October. The plants appear to be suffering from lack of root space, though spacing is wider than is customary in Egypt. —B.C.I.R.A.

Cotton Root System Development: Sudan (Gezira). H. Greene. *Wellcome Trop. Res. Lab., Khartoum, Report of Cotton Growing Meeting*, Sudan Gezira, Dec. 1925, p. 35.

Not a single well-formed tap root has yet been found on the cotton plant in the Gezira area. One reason lies in the fact that the moisture content falls off from 30% to 40% at the surface to about 20% at 1½ to 2 ft.; and very little of this 20% is available to the plant. The soil is hard, alkaline, very compact and practically unaffected by ordinary watering. It may, however, be more open to attack immediately before the rains. —B.C.I.R.A.

Cotton Demonstration Plots: Sudan (Gezira). V. P. Walley. *Wellcome Trop. Res. Lab., Khartoum, Report of Cotton Growing Meeting*, Sudan Gezira, Dec. 1925, p. 36.

Steady decreases in yield are recorded from the cotton-fallow rotation, and lubia, fed off by cattle and sheep, in rotation with cotton has shown a steady improvement in cotton yield. Cotton has been grown continuously for eight seasons on one plot with no alarming yield depreciation. Sulphate of ammonia and farmyard manure gave good results, and the crop matured earlier with the latter dressing. August 15th is the optimum date for sowing.
—B.C.I.R.A.

Cotton Fertiliser Experiments in the Sudan. *Wellcome Tropical Research Laboratories, Sudan, Report of the Government Chemist*, 1925, p. 20-21.

Sulphate of ammonia dressings for Sakel cotton were found most beneficial at 60 days after sowing, a result agreeing with the experience of 1921-1922. Another high value occurred for applications after 120 days' growth, which is more in accord with the results in 1924 when the best returns were obtained after 105 days. Gypsum applications increased the quantity of soluble salts and a satisfactory response to the treatment was evinced by increased yields. —B.C.I.R.A.

Chang Yin Sha Mien Cotton: Characteristics. T. S. Kuo and F. M. Chou. *Bot. Abs.*, 1926, **15**, 731 (from *Ko-Hsueh: Science-Publ. Chinese Sci. Soc.*, 1925, **10**, 476-494).

The origin of the "Chang Yin Sha Mien" variety and the detailed plan of its line breeding are described. The pure line of the variety runs well through five years' breeding test (self-pollination). This cotton is said to be the best Chinese variety and it has the following characters—Staple length, about 1 in.; lint index, 5 gm.; lint percentage, 35-42; early maturity, big boll and high yield. The quality of the fibre, however, is coarse and the plant has very low resistance to the attack of leaf-roll disease. Field records of plant growth are tabulated. —B.C.I.R.A.

Cotton Cultivation in India (Berar). *Indian Text. J.*, 1926, **34**, 280.

The soil and climate of Berar, Central Provinces, are suitable for growing cotton, which has replaced wheat and millet as a major crop. Cotton would be planted continuously if soil fertility conditions allowed, and land rents are increasing progressively. The author predicts a demand for quick-acting artificial fertilisers, when once their importance is appreciated by the cultivator. The purchasing power of the Berar growers appears to be well able to meet the cost of fertilisers.

—B.C.I.R.A.

Cotton Seed Oil: Disappearance during Germination. E. E. Randolph. *Bot. Abs.*, 1926, **15**, 810 (from *J. Elisha Mitchell Sci. Soc.*, 1925, **41**, 124-128).

When sound cotton seed is germinated the oil content (including both seed and seedling) drops from 19·5 to 16·75% during the first three days. In the next three days the drop continues to 7·5%. About this time the seedling breaks through the seed coat. On the 15th day the oil is practically gone. In the usual slight warehouse heating, the oil content does not drop appreciably if the seed can be worked whilst still damp. If allowed to dry the loss is considerable. —B.C.I.R.A.

Formula for Cellulose; A Suggested Constitutional——. H. le B. Gray. *J. Ind. Eng. Chem.*, 1926, **18**, 811.

The author proposes a formula for cellulose which is in accord with recent progress in cellulose chemistry, taking cognisance of evidence, as shown by viscose and cellulose xanthoanilide, which indicates that one hydroxyl per C_{24} is different from the other 11 hydroxyls. —L.I.R.A.

Cotton Plants in the West Indies and South America; New Types of——. *J. Ind. Eng. Chem.*, 1926, **18**, 864.

The discovery of several new types of cotton in the West Indies and South America is reported by members of the U.S. Department of Agriculture Bureau of Plant Industry. One of the new types of cotton plants has bracts that are open or turned back from the buds and young bolls so that little protection is afforded for boll weevils or other pests. —B.C.I.R.A.

Pectin. J. W. McKinney. *J. Soc. Chem. Ind.*, 1926, **45**, 301T-304T.

A review is given of the present-day knowledge of pectin, which, however, is not up to date, as recent work by F. Ehrlich on the pectin of sugar beet and of flax is not mentioned. Some experiments on extraction and purification show that the ash of pectin can be reduced to 0·5%.

—L.I.R.A.

Egyptian Cottons: Improvement in——. V. M. Mosseri. *Bot. Abs.*, 1926, **15**, 733 (from *Bull. Inst. Egypt*, 1920, **2**, 11-33).

The author reviews the work of Balls and points out the necessity of remedying both the diminution of yield and the deterioration of quality in Egyptian cottons. Yield is the product of number of plants per unit of surface, mean number of bolls arriving at maturity per plant, and mean weight of cotton seed in one boll. Each of these factors is sub-divided into other factors, of which the author has made a study. Quality is the combination of cleanness, colour, lustre, length, fineness, strength, curliness, elasticity of each fibre, proportion of waste and uniformity of each of these characters. The author has shown that these characters are almost all quantitatively heritable, fluctuating between definite limits of variability and depending on cultural and climatic conditions. Positive and negative correlations between these characters are given. The method of study involves each year, choice of parent plants, selection of 1st, 2nd, and 3rd generation plants and the growing and comparison of these line pedigrees with selection of the best line for further breeding. The author finds that this method permits the use of seed not more than six years from the parent plant and the preservation of advantageous mutant types and new varieties resulting from pure line crosses. —B.C.I.R.A.

Seedling Cotton: Inherited Chlorophyll Deficiency. G. N. Stroman and C. H. Mahoney. *Chem. Abs.*, 1926, **20**, 932 (from *Texas Agr. Expt. Station* Bull. No. 333, 1925, 22 pp.).

The hereditary behaviour of two deficiencies in green colouring matter in seedling cotton is reported. These two characters, one of which is yellow seed leaves instead of the usual green and the other the lack of green colour in certain portions of the seed leaves, are important defects not only because of their scientific interest but also because the presence of these characters in a field of cotton lessens the vigour of the plants. The two characters mentioned are shown to be inherited and the relations of the genetic factors concerned have been discovered. —B.C.I.R.A.

***Melampsora lini*; Inheritance of Immunity from——.** A. W. Henry. *Rev. App. Mycol.*, 1926, **5**, 490 (from *Phytopath.*, 1926, **16**, 87).

Crosses were made between varieties of *Linum usitatissimum* immune from and susceptible to *Melampsora lini*, including both fibre varieties (flax) and seed varieties (linseed). Three immune parents were used, namely, a selection of commercial Argentine flax, Bombay, and Ottawa. The F_1 plants of all crosses were immune. The segregation in the F_2 cross between the Argentine selection and the susceptible Saginaw fibre variety approximated to a ratio of 15 immune plants to one susceptible. The F_2 of a cross between Bombay and the susceptible Winona linseed showed a simple monohybrid segregation. Apparently there was a single factor

difference between immunity and susceptibility in a cross between Ottawa and Saginaw. A ratio of three blue-flowered, brown-seeded plants (Saginaw) to one white-flowered yellow-seeded plant (Ottawa) was obtained in the F_2. These characters are approximately linked, and were inherited independently of immunity from rust, so that in the F_2 a segregation approximating to a 9 : 3 : 3 : 1 ratio was obtained. —L.I.R.A.

Cotton Pests in Cyprus: Control. D. S. Wilkinson. *Rev. Appl. Entomol.*, 1926, **14**, 370 (from *Cyprus Agric. J.*, 1926, **21**, (2), 47-48).

Investigations are being made with a view to controlling *Earias insulana* and *Platyedra gossypiella* by planting early-producing varieties of cotton. So far the varieties tested, such as Triumph, show as much as one-third of the bolls to be attacked or otherwise in a diseased condition as a result of insect attack. —B.C.I.R.A.

Light on Cotton; The Action of——. H. Kauffmann. *Melliand's Textilber.*, 1926, **7**, 617-618.

The action of light on purified cotton cellulose has been studied. Ultra-violet light causes weakening of the fibre and the appearance of many of the chemical properties of oxycellulose. These are here ascribed to an alteration product of cellulose named "photocellulose," which may be produced even in absence of oxygen. It could not be distinguished from cellulose by ultimate analysis or reducing power towards acid permanganate. In bleaching by grassing, photocellulose is produced in small quantities. —L.I.R.A.

Flax Fibre Strands: The Breakdown of, during the Preparing Processes. J. A. Matthews. *J. Text. Inst.*, 1926, **17**, T405-434.

(D)—Artificial

Cellulose Ester Solvents. J. G. Davidson. *J. Ind. Chem.*, 1926, **18**, 669-675.

The ether derivatives of the alkyl glycols are good solvents for cellulose esters. The mono-ethyl ether of ethylene glycol is a more powerful solvent for nitrocellulose and stands dilution with non-solvents better than any other solvent of comparable boiling range that has been examined. The physical properties of some of the monoalkyl ethers of ethylene and propylene glycols and of some polyglycols and their ethyl ether derivatives are tabulated, and a table is also given showing the solvent powers of various solvents, including some glycols, for cellulose nitrate, cellulose acetate, resins, and gums. The use of the glycol ethers in the lacquer industry is discussed. —B.C.I.R.A.

Cellulose Acetate: X-ray Structure. E. Ott. *Helv. Chim. Acta*, 1926, **9**, 378-379.

The author has proved the crystal structure of a cellulose acetate prepared by a method used by Karrer. The Röntgen diagram is reproduced. The interference lines are not of sharp definition, which points to a small crystallite size. The intensity of the lines also is low. Kahlbaum's cellulose acetate was used as a check material; crystal structure was evident, but the lines were less distinct than before. —B.C.I.R.A.

Artificial Silk Products. W. Suchanck. *Silk J.*, 1926, **3**, No. 27, 57-60.

Some developments of recent years in the artificial silk industry are discussed. The article deals with the production of fine-fibred viscose silk, "washing silk," hollow or gas-inflated filaments and artificial wool. —B.C.I.R.A.

"Chatilaine" and "Seris": Properties. *Silk J.*, 1926, **2**, No. 24, p. 65.

Both are staple fibres produced by the Italian firm La Soie de Chatillon. Chatilaine is a woolly fibre very like natural wool in appearance. Its strands are regular and generally of a constant length of 5-6 inches. It lends itself to the manufacture of knitted fabrics, producing attractive goods which are washable, unshrinkable, and not irritating to the skin. Seris is produced in three types, "10/S" which has strands of 0·8/1 den., "25/S," strands of 2·2/5 den., and "35/S," strands of 3·3/5 den. It is claimed that type 10/S rivals in fineness the best natural silk. The surface of the fibre is such that a comparatively high frictional resistance to slipping is secured. The fineness of this fibre imparts to cloth a suppleness, "feel," and appearance similar to that of natural schappe. Seris, especially the 10/S type, can be spun alone. Yarn spun from a mixture of Seris and natural schappe is claimed to be practically indistinguishable from all silk yarn when knitted, owing to its elasticity. Types 25/S and 35/S combine well with cotton when cut to the length of the cotton staple and weave into soft, strong cloth of lustrous silken appearance. Seris of type 35/S, cut to convenient lengths, is combed with wool and worked up into fine cloths. —B.C.I.R.A.

Cuprammonium Cellulose Solutions: Application. J. Foltzer. *Silk J.*, 1926, **2**, No. 24, p. 59.

Subsidiary uses for cuprammonium cellulose solutions include the production of artificial wool, staple fibre, straws, artificial horsehair, monosilk, films, transparent sheets, imitation bone ornaments, varnishes, and artificial cloths and leathers. The properties and manufacture of these products are briefly discussed. —B.C.I.R.A.

Chitin Artificial Filaments: Preparation. G. Kunike. *Kunstseide*, 1926, **8**, 182-183.

The occurrence, chemical properties, and the method of isolation of the skeletal substance chitin are summarised. It may

be dissolved in certain concentrated acids to a colloidal viscous solution. A solution containing 6-10% chitin may be spun, preferably wet, by the stretch-spinning method or by the viscose method. Practically any of the liquids in which chitin is insoluble, e.g., alcohol, acetone, dilute solutions of acids or alkalis, can be used in the spinning bath. The filament has a round to heart-shaped cross section and possesses a tensile strength of 35 kg./sq. mm. It has a matt appearance and in finer qualities finds application as artificial human hair. Chitin films which can be prepared by the nitrocellulose method or by wet precipitation are as transparent as glass and possess high folding strength. A patent has been applied for by R. O. Herzog and the author to cover the manufacture of plastics from chitin. The chitin should be obtainable from waste crab and lobster shells &c. —B.C.I.R.A.

Artificial Silk: Control of Lustre. *Melliand's Textilber.*, 1926, **7**, 622 (from *Mon. maille*, 1925, 81).

Artificial silk can be treated with sodium hydroxide without damage to the fibre if it is first coated with a colloid such as gelatin. If the coated fibre is treated with ordinary mercerising solutions under very little tension and passed immediately to an acid bath to remove adhering alkali the cross section is apparently changed; light is not so strongly reflected from the surface of the fibre and the hard lustre disappears so that the fibre approximates more nearly to natural silk in appearance. The strength of the fibre is in no way diminished. If the treatment is carried out under tension there is no change in the structure of the silk; under no tension considerable shrinkage, which may amount to 20%, occurs. The lustre of artificial silk can, therefore, be modified as desired by varying the tension during mercerisation. The process can be applied to mixed fabrics of cotton and artificial silk. It is carried out in the usual way except that the artificial silk is coated with the colloid and adhering alkali is removed in a dilute acid bath. When the usual tension is applied the artificial silk undergoes no change, whilst the cotton acquires a high lustre. The addition of glycerol to the mercerising solution protects the artificial silk still further from attack and if the treated fabric is to be scoured, bleached, &c., the addition of aluminium acetate to the gelatin is recommended. —B.C.I.R.A

Rayon from Acetate Cellulose. *Silk J.*, 1926, **2**, No. 22, p. 48.

Cellulose is treated in a mixer with acetic acid and acetic anhydride until finally acetylised, and in a few hours yields a clear viscous solution. 100 parts of cellulose yield 175 parts of the acetate. Water and heat are applied to ripen the solution to a stage when it is soluble in acetone. The addition of excess of water causes coagulation in a compact flaky mass. The actual works scale process is not simple as there are many forms of acetate and there is consequent risk of lack of uniformity of output. The usual process of spinning is to extrude a solution in acetone, &c., of the washed and dried acetate into an atmosphere of warm air; the fibre dries as it is spun, a number of fibres can be twisted together and reeled at high speed. Acetate rayon loses only 20-25% of its strength when wetted as compared to 60-75% with other varieties. Strong alkalis will saponify it, but it withstands ordinary washing well. —F.G.P.

Transforming Cotton Yarns and Fabrics immediately into Rayon Silk. *Silk J.*, 1926, **2**, No. 22, p. 56.

Cotton yarn and fabric are dipped in a nitrating solution, and suitably washed. The process is not yet commercial. [Unless special precautions are taken, which are not mentioned, the resulting material would be very dangerously inflammable.] There is considerable loss of strength and the fabric is more susceptible to chemical attack during milling. There is increased affinity for most classes of dyestuffs. —F.G.P.

Rayon from Prepared Pulp. *Silk J.*, 1926, **2**, No. 22, p. 58.

A special high grade bleaching sulphite pulp is now being prepared in Canada especially for the British and American rayon industry. Although it costs rather more than ordinary pulp it yields more and finer fibre. —F.G.P.

Hydration of Cellulose. C. J. J. Fox. *Chem. Abs.*, 1926, **20**, 2069 (from *Paper Maker and Brit. Paper Tr. J.*, 1926, **71**, 366-366A).

The author considers that the facts that cellulose hydration curves are unbroken (indicating a continuously variable vapour pressure consistent only with the presence of physically held water) and that lack of evidence of the existence of a definite vapour pressure (such as would be expected in the case of a true hydrate) favour the non-existence of a cellulose hydrate, but is not conclusive proof. —L.I.R.A.

Viscose: Ripening. R. O. Herzog. *Kolloid-Z.*, 1926, **39**, 252-262

To avoid further controversy the author publishes an account of the experimental work which has led to publications on the viscose ripening process. The paper covers ultramicroscopic observations, accurate photographic measurements of the micro-diffusion of viscose into caustic soda solution (from which particle size can be calculated), viscosity determinations at different stages of ripening and an examination of the optical properties of strained viscose films. The results regarding particle size at successive stages of ripening have been fully discussed in the earlier papers. —B.C.I.R.A.

Sulphite Cellulose: Fluorescence. C. W. Leupold. *Papier-Fabr.*, 1926, **24** (Verein Zellstoff Ingenieure Section), 397-398.

Ultra-microscopic examination of sulphite lyes revealed the fact that fluorescence which developed under 24 hours' light action was due to a rise in concentration of fine, dispersed colloidal sulphur particles. The presence of free sulphur is explained by assuming that some sulphurous acid is reduced to sulphur which is drawn into the highly permeable fibre colloid, or that thiosulphate is formed, and is taken up by the fibre in which it deposits free sulphur with liberation of sulphur dioxide. —B.C.I.R.A.

Sulphite Cellulose: Fluorescence. O. Gerngross and K. Tsou. *Papier-Fabr.*, 1926, **33** (Verein Zellstoff Ingenieure Section), 497-499.

In reply to Leupold the authors bring forward further experimental evidence to prove that the fluorescence is due, not to colloidal sulphur, lignin sulphuric acid or other extraneous matter, but to a natural substance occurring in the free state and sharply localised in the living secondary bark of spruce, but also occurring in the wood where it is usually bound more firmly than in the bark. —B.C.I.R.A.

Alkali Cellulose: Ripening. M. Numa. *Cellulosechem.*, 1926, **7**, 136 (from *Cellulose Ind.*, *Tokyo*, 1926, **2**, 13).

The colloidal properties of celluloses regenerated from alkali cellulose at different stages of ripening were investigated, namely, the viscosity of the ammoniacal copper oxide and xanthate solutions, the mechanical properties of the viscose films and the best conditions for ripening of alkali cellulose. It is shown that the colour intensity of the cuprammonium cellulose solutions is directly related to the degree of dispersity, the maxima being shown in both cases by colloid-chemically unchanged cellulose; also that the ripening process only begins five hours after the expressing process. Air and sunlight accelerate ripening, but nitrogen gives no better results than are obtained when air and light are excluded. Viscosity and colour intensity of the cellulose solutions attain maximum values some time after the expression, to fall off again when ripening begins. The best ripening time at low temperature with exclusion of light and air is 5-20 hours. —B.C.I.R.A.

German Artificial Silks: Physical Properties. Dr. Reinecke. *Melliand's Textilber.*, 1926, **7**, 542-543.

A further reply to Mesenholl. Tests have been made on 32 varieties of artificial silk. The results are tabulated and the author considers they prove the equality and partial superiority of the German product. —B.C.I.R.A.

Artificial Silk Yarn Properties. See Section 7H.

Patents

Mechanical Cotton Picker. P. Ferrier. F.P.597,094.

The fibres are sucked up through a grid-belt, then nipped between the belts and cylinders, and carried away by exhausters. A set of wires with hooks is used for stripping and makes piercing through the grid easier. —Bur. Text.

Viscose: Spinning. Erste Böhmische Kunstseide A.-G. Czecho-Slovak P. 16,622 (from *Melliand's Textilber.*, 1926, **7**, 560).

In a process for the preparation of lustrous filaments, ribbons, films, and plates of viscose, 5% of ammonium sulphate is added to a normal sulphuric acid-sodium sulphate spinning bath of at least 1·35 specific gravity. Under these conditions the critical acidity of the spinning bath can be overstepped without the formation of small bubbles in the fibre. Abnormal viscose solutions of low grade cellulose can also be spun without the formation of bubbles if more than 5% of ammonium sulphate is added. —B.C.I.R.A.

Hollow Viscose Filaments; Preparation of——. Courtaulds Ltd., London, S. S. Napper, Woking, H. D. Gardner, Wallington, H. J. Hegen, and F. Bayley, both of Coventry. E.P.253,953 and 253,954.

Hollow threads, filaments, bands, &c., are made by projecting into an acid bath containing a zinc salt in solution, a viscose containing either a fluid, in suspension or emulsion, which in the bath will give rise to a gas, or alternatively a substance such as sodium carbonate which in the setting bath gives rise by chemical action to bubbles within the filaments, &c. A second method of production employs a viscose in the preparation of which not less than 3% and not more than 5% of caustic soda has been employed; the viscose to be used otherwise contains 6-8% of cellulose, and is prepared with 30-40 parts of carbon disulphide to 100 parts of cellulose. Additions as above may be made to the viscose solution but such an addition is unnecessary if the proportion of caustic soda in the viscose is low. In an example, a viscose prepared from a ripened alkali cellulose is dissolved in dilute caustic soda and a solution of sodium carbonate is added. After subjection to a vacuum the viscose solution is spun in a bath such as is described in Specification 406/11. —B.C.I.R.A.

Viscose Silk Skein: Grading for Dyeing. Courtaulds Ltd., London, and C. M. Whittaker, Cheadle Hulme. E.P. 254,531.

For the purpose of obtaining batches of viscose silk having practically the same dyeing affinity so that fabrics made therefrom can be dyed the same shade, a

quantity of the artificial silk in portions or skeins is dyed with an easily removable dye, preferably one that tends to dye unevenly, and the dyed artificial silk is sorted into batches each consisting of those skeins which are dyed to the same shade. The dyeing agent is subsequently removed.
—B.C.I.R.A.

Artificial Silk Spinning Nozzles: Grinding. L. A. Levy, Cricklewood, London. E.P. 255,261.

When grinding the ends of the capillary tubes, particularly glass tubes, constituting nozzles for spinning artificial filaments, a liquid such as water or oil is forced through the capillary, and at intervals the quantity of liquid passing in a given time is measured until this quantity reaches a definite fixed value. The passage of the liquid also prevents choking of the nozzle during the grinding operation.
—B.C.I.R.A.

Hollow Artificial Silk Fibres: Preparation. M. Lanfry, Houilles, S. et. O., France, and J. E. Brandenberger, Bezons, near Paris, France. E.P.255,527.

For the manufacture of hollow glossy fibres of artificial silk from viscose to which alkali carbonate has been added, the proportion of caustic alkali to cellulose in the viscose is less than 1 : 1·2, and the proportion of sulphuric acid and sodium sulphate in the coagulating bath is given by a diagram. It is convenient to use a viscose containing 7·3% of cellulose, the practical working limits of the proportion of caustic alkali being 4-6%. The curves shown on the diagram serve to correlate the ripeness of the viscose, the proportion of caustic soda in the viscose, the density of the coagulating bath, and the proportions of sulphuric acid and sodium sulphate in the bath. Examples of the use of the diagram are given. The carbonate necessary for the production of hollow fibres may be introduced into the viscose solution as such or it may be formed in the solution by the addition of carbon dioxide or bicarbonate, when the quantity added must be sufficient to react with at least 0·5% of the caustic soda. —B.C.I.R.A.

Artificial Silk: Manufacture. R. Attwater and A. Heinemann, Penwortham, Preston. E.P.255,623.

In the manufacture of artificial textile fibres, the solution to be spun is prepared by adding to a solution in caustic alkali of an albumenoid such as keratin, fibrin, spongin, or konchœlin, cellulose, and carbon bisulphide, sufficient caustic alkali being added to maintain the mixture alkaline. The manufacture proceeds as for viscose silk. In an example, the albumenoid solution is prepared by dissolving feathers, horn or hoofs in caustic soda solution.
—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Production of Mineral Fibres—

254,796. S. H. Dolbear and Selective Treatment Co. Ltd. Separation of Asbestos Fibres from its Ore.

Production of Animal Fibres—

255,398. W. Whitcomb. Sheep shearing machine.

Production of Artificial Fibres—

254,253. British Enka Artificial Silk Co. Rotary pump.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Punjab-American Cotton: Ginning. *Indian Central Cotton Committee Technological Laboratory Pamphlet*, 7 pp.

The results of comparative spinning tests on roller-ginned and saw-ginned Punjab-American type 289F cotton grown in the Lower Bari Doab Canal Colony in the season 1925-1926 show that the saw-ginned material is in every respect superior to the roller-ginned, even in fibre length.
—B.C.I.R.A.

Cotton Ginning in the U.S.A. G. S. Meloy. *U.S. Dep. Agric., Farmer's Bull.* No. 1465, pp. 27.

The machinery equipment of the modern ginnery including bolly machines, boll extractors, boll breakers, beaters, and cleaners are illustrated and attention is drawn to the necessary precautions required at each stage. The installation of special small hand-fed gin sets for the ginning of seed cotton, from which the seed is required for sowing purposes, is recommended in each ginnery. The merits of 12 in. saws and of the air blast in place of 10 in. saws and the brushing system for removing lint are briefly discussed. Attention is also drawn to the general superiority of Indian and Egyptian baling methods over those of America. —B.C.I.R.A.

Gégauff Card-stripping Mechanism. J. Pflimlin. *Bull. Soc. Ind. Mulhouse*, 1926, **92**, 217-229.

In a general article on methods of stripping the cards of cotton carding engines, the continuous card-stripping mechanism of Gégauff-Pflimlin is described in detail.
—B.C.I.R.A.

Raw Cotton: Oil Spraying. Texas Textile Association. *Cotton*, 1926, **90**, 773

A reported discussion. Two spinners stated that the cardroom and carding machinery were cleaner when the cotton was sprayed, but that in the spinning-room a condition described as a "snowstorm" prevailed. A third spinner stated that he applied the oil by means of a humidifier

head. He found that fly was reduced and static electricity in the cardroom eliminated; he did not observe the "snowstorm" condition nor any change in the breaking load of the yarn. A fourth speaker found that, whilst fly was reduced, he did not get a good web from the card. —B.C.I.R.A.

Roving: Weight Variations. Texas Textile Association. *Cotton*, 1926, **90**, 773-775.

A discussion on methods of keeping weights of roving and yarn uniform and the variation to be expected in yarn from different frames. One speaker adopts a bone-dry basis. Samples are taken from the draw frames and slubbers twice a day, dried at 220° F. and any change made is based on changes in the bone-dry weight of the samples. He finds that the regain varies from 5-9% but that the bone-dry weights do not change much. —B.C.I.R.A.

Adjustable Comber Trumpet. A. J. Blackwood. *Cotton*, 1926, **90**, 801.

The device is an improved form of trumpet and stop motion for the Heilman type of comber. The trumpet is provided with a groove and by means of a set screw can be held at any desired distance from the calender rollers, this distance being determined by the length of the staple used. The device obviates breakage of sliver after passing through the rollers because the mouth of the trumpet is too close to the rollers and one end of the fibre is within the trumpet whilst the other is grasped by the rollers. —B.C.I.R.A.

Combing Machine: Function. "Jock." *Cotton*, 1926, **90**, 801-811.

Replying to a letter in which it is claimed that the half-lap combs approximately 90% of the cotton, the author explains with the help of diagrams the action of combing machines and maintains that only 50% of the cotton is combed by the half-lap.
—B.C.I.R.A.

Artificial Wool and Woollenised Cotton. *Text. Argus.*, 1926, **3**, Oct. 6th, p. 4.

Artificial wool is produced by treating, with concentrated nitric acid, cotton which has been previously impregnated with casein, by a type of viscose process using the wood of the poplar tree as a raw material, and by the formation of air bubbles within cellulose artificial silk. The latter type of silk (Celta) is now being manufactured at Peterborough. Woollenised (or "philanised") cotton is obtained by treating cotton with nitric acid, the strength and extensibility of the cotton being thereby increased while its heat conductivity is decreased. —A.J.H.

Case-hardened Fibre Bobbins. *Silk* (N.Y.), 1926, **19**, No. 3, p. 36.

This material is 50% less susceptible to moisture and has 15% greater density than ordinary fibre and is being used, it is said, by silk mills all over America. The makers also produce a non-corrosive metal bobbin for steaming. —F.G.P.

Carding Engine: Control and Functions. H. Rudolph. *Melliand's Textilber.*, 1926, **7**, 1-3, 124-126, 214-215, 304-305, 407-408, 581-584.

A further article dealing in general with the angle of inclination, material of construction and grinding of the card wires, card foundation material and the arrangement of the wires in card clothing, the functions of the roller and clearer and the adjustment of the working parts of the card, and in particular with the working parts of cotton and wool cards and their functions and general practice in the carding of cotton and wool. —B.C.I.R.A.

(B)—Spinning and Doubling

Artificial Silk Spinning and Reeling Machines. *Silk J.*, 1926, **3**, No. 27, 72-73.

A double-sided centrifugal spinning machine and a hank reeling machine with a new type of reel in which a slight touch of the thumb causes the reel staves to collapse are described. Both machines are built by the firm of C. G. Haubold, Chemnitz.
—B.C.I.R.A.

Latsch High Draft System. O. Latsch. *Cotton*, 1926, **90**, 799.

The top middle roller is positively driven by individual gears from the bottom roller. This arrangement is said to preclude the possibility of uneven draft through the rotary impulse effect of the moving fibres on the top roller which may occur when the top middle roller is driven by frictional contact with the bottom roller. The distance from centre to centre of the middle and front rolls is about $\frac{3}{4}$ inch and the draft between the back and middle rollers is considerably higher than usual.
—B.C.I.R.A.

Werning High Draft System. C. Ros. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 218-219.

The Werning three-cylinder high draft system is described and its advantages over four-cylinder and other systems employing fluted rollers is discussed. The diameter of the front rollers is $\frac{7}{8}$ in.; there is a middle "fish scale" fluted roller $\frac{11}{16}$ in. in diameter and a middle pressure cylinder of 17 mm. diameter and a weight of 140-150 grms. The distance between front and middle rollers is 20·5 mm.; the nip points of the middle pair of cylinders is below the level of those of the front and feed rollers; the inclination of the system is 30°. The yarn passes to the spindle nearly vertically. The system was employed with success in spinning from the bad quality material which had to be worked during the war, and yarns with 8-10% less twist can be spun with the system. —B.C.I.R.A.

Fluted Roller High Draft Systems: Advantages. M. Lehmann. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 299-300.

The author continues the controversy as to the relative merits of fluted and smooth rollers in high draft systems. He submits that tensile strength tests are not alone sufficient to judge of the quality of a yarn, and furnishes additional results in support of fluted rollers employed in three and four cylinder systems. —B.C.I.R.A.

Ring-spinning Frames: Yield and Efficiency. Olle Wikström. *Melliand's Textilber.*, 1925, **6**, 807-808.

The efficiency of a ring-spinning frame is defined as the ratio of actual production per given time to the production which would be possible in the same time if the machine were run continuously. In calculating the latter production, an expression is derived for production per spindle hour from the revolutions per minute of the main shaft, the spindle and the front roller, and the tooth number of the tin roller gear wheel, the twist wheel, the front roller gear wheel and the twist change wheel. The production possible in the observed time of doffing and replacing bobbins is obtained experimentally by weighing the yarn on a bobbin which has run for the observed time. The sum of the two productions is the theoretical production of the machine. The calculation is important as showing that for yarns of different counts the production per spindle hour is inversely proportional to the cube of the square root of the count and not to the square root of the count. —B.C.I.R.A.

Indian Cotton Spinning Tests. See Section 6.

PATENTS

Stop Motion for Spinning Frame. A. et K. Walks. F.P.597,337.

This device, for linen, jute, and top spinning, comprises a feeler arm which allows, in the case of breaking yarn, the falling of a bar, so that a pawl can come into action with a ratchet wheel. This pawl moves a vibrating finger which lies upon a bowl supported by the stop level of the sliver. —Bur. Text.

Soft Twist Roller Drafting System. Carl Hamel A.-G. D.R.P.410,586 (from *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 225).

The spindle is vertical and there is a nearly vertical arrangement of the front pair of drafting rollers over the yarn guide. By this arrangement the yarn twist is transmitted up to the nip point of the delivery rollers. The arrangement provides a steeply inclined position of the draft rollers and a distance between the front pair and the yarn guide which is at least double that of ordinary ring spinning frames. —B.C.I.R.A.

Roving Frame Gearing. L. Hemsley, Heaton Chapel, Stockport, and J. Hetherington & Sons, Ltd., Ancoats, Manchester. E.P.254,149.

The patent relates to differential gearing of the Curtis and Rhodes type for roving frames and comprises a construction whereby the reduction gear is dispensed with so that larger planet pinions may be used and a greater number of the teeth of the planet pinions are in gear with those of the driving pinion, and whereby the gearing may be completely enclosed. A gear wheel on a sleeve which is driven from the cones in the opposite direction from that of the shaft that drives the spindles, gears with planet wheels on a carrier fast on the shaft, and the wheels mesh with internal teeth on a drum which is freely mounted on the shaft and drives the bobbin gearing by means of a wheel. A cover plate may be fixed on or over the drum so as to enclose the gearing and retain lubricant. —B.C.I.R.A.

Winding Machine. J. D. Joyce, Philadelphia, U.S.A. E.P.254,267.

A yarn winding machine, particularly for winding double taper-ended cops for loom shuttles, is provided with a progression wheel mounted on the traverse bar and movable transversely thereof to feed the guide along the bar, and also with means to adjust the wheel in lateral relation to the winding spindle and the bar as the cop increases in diameter. The wheel is held eccentric of the bar and close to the spindle at the beginning of winding and is adjusted towards its concentric position as the cop increases in diameter. —B.C.I.R.A.

Carding Engine Driving Gear. Siemens-Schuckertwerke Ges., Berlin, Germany. E.P.254,318.

In an arrangement for driving the machines of a set of carding engines by asynchronus motors, which are electrically coupled on the stator and the rotor sides, to secure "a uniform running on starting, during work, and when running out," the fly-wheel movements of the machines and of their motors are adapted to one another. The output of the individual motors is adapted to the normal torques of the machines, or the fly-wheel movements are adapted to the output of the motors. The motors have rotors wound for equal tension and transformers may be inserted in the rotor circuits. Where motors of different sizes are employed reactances may be mounted in the rotor circuit. —B.C.I.R.A.

Roughened Fibres; Preparation of——. Ober-Rhenische Handelsges and L. Ubbelohde, Karlsruhe, Baden, Germany. E.P.254,357.

In a process for roughening fibres and rendering them more suitable for spinning, roughening agents such as powdered glass are used in a wet or dry state and need not be completely removed before spinning.

The roughening agents may be added at any stage in the manufacture of fibres and may be mixed with substances favouring adhesion such as a greasing agent. Substances having less sharp edges such as silica gel may be used. —B.C.I.R.A.

Spinning Mule Tin Roller Driving Gear. R. Stocks, Burnley, and G. Haworth, Crawshawbooth, both in Lancashire. E.P.254,447.

In an arrangement for driving the tin roller at two speeds during the outward run, the rim band pulley is loose on the tin roller shaft and is mounted to slide on a sleeve carrying a bevel pinion. The rim band pulley is formed as one part of a clutch and can be moved by a lever to engage the other part fixed on the shaft. When the clutch is open at the beginning of the outward run the drive is transmitted from the rim band pulley through four reduction gears, two of which are mounted on the shaft, and a third is held stationary by a pawl engaging a ratchet wheel on the boss of the gear. When the clutch is closed and the ratchet wheel is freed the drive is transmitted directly through the clutch. —B.C.I.R.A.

Artificial Silk Twisting and Winding Apparatus. T. A. Boyd, H. A. Boyd, and J. & T. Boyd, Ltd., Glasgow. E.P. 254,586.

Filaments exuded from nozzles as in the manufacture of artificial silk are wound, or are twisted and wound, upon conical bobbins arranged to have a predetermined uniform "take-up" unaffected by the speed of discharge from the nozzles, or are twisted and wound upon parallel or conical bobbins by means of a flyer so mounted that the bobbin may be removed without removing the flyer. For twisting the filaments a flyer driven by a pinion from a shaft is carried by a sleeve which is reciprocated to lay the filament by a fork, the bobbin spindle being moved longitudinally to build the bobbin by means of a pinion which engages a rack on a slide. The bobbin spindle is splined in a pinion by which it is driven, and is connected by a clutch with the slide. The rack pinion is frictionally driven by a shaft so that the slide may be drawn forward by a handle to start the winding on an empty bobbin. The bobbin spindle is driven at the speed necessary to give the required twist, and, by preference, the flyer is driven at a less speed to ensure the required "take-up" and such speed is varied in accordance with the diameter at which winding is taking place. When winding only, the flyer is omitted and the bobbin driven at a variable speed to ensure a uniform "take-up." —B.C.I.R.A.

Bobbin-Turning Machines. E. Schweizer, Basle, Switzerland. E.P.255,110.

In a machine for operating on rotating work to form articles such as cylinders, rolls, bobbins, spools, &c., from wood or other material, the stock from which the articles are to be made is fed intermittently through a rotating hollow spindle and is bored by an axial rotating drill and shaped and cut off by rotary cutters mounted on both sides of the work. Two alternative machines for turning bobbins are described. —B.C.I.R.A.

Cross-Winding Machine Traverse Mechanism. H. Schweiter and Maschinenfabrik Schweiter A.-G., Horgen, Switzerland. E.P.255,267.

In cross-winding machines provided with automatically variable traverse mechanism and in which the spindle and the cam drum are driven at a constant speed, the reciprocating thread guide or a member connected to it, actuates mechanism to impart axial movement to the cam drum, so that the traverse of the guide is varied to produce tapered or bulged bobbins. —B.C.I.R.A.

Ring Traveller Holder. E. Amant, Alost, Belgium. E.P.255,274.

Travellers are stored on hollow tubes of paper, cardboard, wood, metal, straw, or other like cheap and yielding material, adapted to engage straight or curved rods, or the ends thereof, of apparatus for placing them on the rings of spinning and twisting machines. The tubes are pinched near one or both ends to form flat portions to prevent accidental displacement of the travellers, and are intended to be sold charged with travellers ready for use. —B.C.I.R.A.

Carding Engine Cylinder Driving Gear. C. R. Schwalbe, Werdau, Saxony. E.P. 255,283.

The cylinders of a set of carding machines arranged in series are driven by gearing from a single shaft running longitudinally of the engine and preferably operated by a motor. If the carding machines are arranged side by side the common driving shaft extends transversely. The shaft is preferably arranged under the floor. It may be driven by a belt and gearing from a line shaft, and the condensing system may be driven directly from this train of gearing. —B.C.I.R.A.

Opening Machine Dust Cages. Howard and Bullough, Ltd., and J. Bancroft, Accrington. E.P.255,285.

In a cotton opener, scutcher or the like, one or more additional dust cages are provided adjacent to the outlet from the beater casing. The material is thrown by the beater against a baffle and falls by gravity on to the additional cage. A dust trunk is provided for the cage or it may be combined with the usual dust trunk. The cotton is fed from a hopper by rollers so as to fall through an inlet on to the beater. The outlet is arranged at a considerable height above the centre of the beater and the grid extends round a large

portion of the beater. Air inlets are provided in the casing and the admission of air can be regulated by a sliding perforated plate. The amount of air withdrawn through the cage can also be regulated. The cage is perforated and provided with an external perforated cover which can be adjusted around the cage. —B.C.I.R.A.

Ring Frame Driving Mechanism. W. A. Rothwell, Walkden, near Manchester. E.P.255,327.

In ring frames and the like and winding machines, the delivery roller shaft is driven at a variable speed by a friction roller which is mounted on a shaft driven by a sprocket chain and bevel gearing from a second shaft and is moved across the face of a disc on the roller shaft by means of an adjustable link, which is oscillated by the member which lays the yarn and is coupled to a lever pivoted about the driving shaft and carrying the bevel gearing. The friction roller is maintained against the disc by means of springs connected to a collar embracing the mounting shaft.
—B.C.I.R.A.

Opening Machine Feeding Mechanism. L. Debelvalet, Montheliard, Doubs, France. E.P.255,412.

The air in the hopper of a cotton opener is heated by radiators for treating the cotton which is fed into the hopper by a lattice. It is carried upwards on a second lattice, any excess being thrown back by a levelling roller co-acting with a clearing roller. This surplus cotton is received on a perforated rotating drum containing a fan, the fixed casing of which is divided by fins into annular zones connected respectively to the suction and delivery sides of the fan. In passing over the suction zone the cotton is subject to the action of air drawn in by the fan. On continued rotation, it is discharged by air passing through the delivery zone to the feed lattice. The cotton on the upward-moving lattice is detached by a beater and projected on to a grid, and is drawn by fans on to a perforated drum, which encloses a second sheet metal drum having an opening through which the suction of the fans is effected. The cotton is delivered by a roller to the scutcher whilst dust is withdrawn through the drum and flues to pipes. An outlet connected by a duct to the flues is also provided. The output of the machine is automatically regulated by a shutter or when the scutcher lap roll is full.
—B.C.I.R.A.

Hank Reel. H. Wade, London (for Universal Winding Co., Boston). E.P. 255,545.

A reel for holding hanks or skeins of yarn or like material comprises two sets of spokes resiliently mounted so that they are rotatable relatively to each other in both directions to facilitate the placing on of the skein. One set of spokes is secured by helical splines in discs secured to a central hub whilst the other set is similarly secured in discs secured to a spindle. These discs engage the free ends of oppositely acting springs anchored to the other set of discs so that normally they maintain the spokes in extended position. Loops of wire or twine secured in notches support the skein.
—B.C.I.R.A.

Spinning Machine Rollers. T. Sefton and T. H. Riley, Bury. E.P.255,595.

The necks of rollers for mules, ring spinning machines, drawing frames and similar machines used in preparing and spinning cotton or other fibrous material are of diminishing diameter from their centres so as to form a ridge upon which the weight hook is mounted, so that fluff or dirt tends to be displaced from the hook and gathers in cavities in the rollers. The rollers are ordinarily leather-covered and may be integral with the neck and journals or one or both may be secured on a shaft by shrinking or by set screws, and abut against a shoulder. —B.C.I.R.A.

Spinning Mule Boot Leg Control Mechanism. J. Pickford, Oldham. E.P. 255,676.

In an arrangement for holding the boot leg out of contact with the locking bowl until the boot leg rises to move into the locked position, the stop means are situated centrally to eliminate any tendency of the parts concerned to twist. One of the stop members, which are of comparatively large area, is carried adjustably on the mule carriage and the other either on the link or on the boot leg itself. —B.C.I.R.A.

Opening Machine Weighing Apparatus. A. Glesser, Haut Rhin, France. E.P. 255,885.

A machine for opening and beating fibres is provided with weighing apparatus, the trough-shaped platform of which receives a finished roller during the starting of the winding of the next roller. Details are given of the weighing apparatus.
—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Preparatory Processes—

254,013. C. Schofield and J. L. Rushton. Feeding arrangement for cotton gin.

254,236. A. L. Blackburn. Bobbin construction process.

254,428. Hall & Kay, Ltd. Suction dust remover for carding engines, &c.

255,123. G. Seymour. Breaking and scutching apparatus.

255,124. G. Seymour. Scutching apparatus.

Spinning—

254,567. R. King. Pressure device for top drawing roller.

Subsequent Processes—

254,398. Universal Winding Co. Bobbin-cradle for drum winding machine.

255,715. L. Pivot and L. Villot. Winding bobbins.

255,775. L. Malina. Groove for yarn knots during unwinding.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Jacquard Card Cutting Machine. J. T. Hardaker, Ltd. *Silk J.*, 1926, **3**, No. 26, p. 77.

In the power-driven, piano card-cutting machine described manual labour is entirely eliminated. The machine is supplied with three pedals which give complete control of the power. The main drive pedal, which controls the special type working head, is in the middle. The left pedal controls the jumper blades, and the right pedal brings the carriage back to zero position without the use of a cord. Immediately in front of the machine is a self-centring device for different widths of cards. The self-centring card guides enable the cutter to change to various widths of cards instantly and without any mechanical adjustment. —B.C.I.R.A.

A Special Oil Treatment for Rayon. *Silk* (N.Y.), 1926, **19**, No. 2, p. 88.

The oil mentioned contains a specially processed ingredient which leaves on the fibre a film capable of protecting it from moisture and resisting the tension it sustains during weaving or knitting. The oil may be easily stripped from the fabric by immersing in a bath of water containing a little tri-sodium phosphate at 120° F. and then rinsing in warm water. Hot soaping is unneccessary and dangerous.

—F.G.P.

Twist-effect Threads: Beaming. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 303.

Alternative methods of beaming coarser, unsized yarns introduced in weaving to give twist effects in materials such as zephyrs are discussed. It is stated that good results can be obtained without the use of an independent twist yarn beam by placing a special creel behind the sizing machine, taking the threads over the size-box rollers and passing them through a special comb to the front of the size-box. They then pass through the squeeze rolls and through a dividing rod, thence passing with the ground warp threads to the drying chamber and to the warpers' beam.

—B.C.I.R.A.

Card Punching and Reading-in Machines. E. Frotscher. *Melliand's Textilber.*, 1926, **7**, 504-506.

Methods which have been proposed for simplifying or performing automatically the preparation of jacquard designs for card cutting and reading-in are reviewed. The earliest proposal was made by Szczepanick in 1899 and the most recent development is the Uhlig machine. —B.C.I.R.A.

(B)—Sizing

Starch: Acid Hydrolysis. D. R. Nanji and R. G. L. Beazeley. *J. Soc. Chem. Ind.*, 1926, **45**, 215-219T.

The authors hydrolysed starch with N/5 sulphuric acid and with 5% oxalic acid, and determined at intervals the amounts of dextrin, iso-maltose, maltose, and dextrose present by an optical rotation method which they describe in detail. Their analytical method gives results different from those which they obtain by Allen's and Ling's methods; the latter are criticised. In the course of their experiments the authors observed that a washed sample of soluble starch was able to fix calcium from water containing as little as 1 part of calcium per 100,000. A 2% solution of soluble starch free from calcium was limpid and had *p*H 4·0. After a week's washing with water containing 1 part of calcium per 100,000, this starch had 11·2% of Ca in its ash, and a 2% solution was now quite opalescent and viscous, with *p*H 6·0. It is concluded that the gelatinising function of ordinary starch is not directly due to the amylophosphoric ester but to the calcium salt of the ester. The observation shows how the physical properties of a starch can be modified by the nature of the saline constituents of the water used in its manufacture.

—B.C.I.R.A.

Starch and Dextrin: Rate of Zymolysis; and Taka-diastase: Effect of *p*H. H. L. Maslow and W. C. Davison. *J. Biol. Chem.*, 1926, **68**, 75-93.

(1) The rate of zymolysis of starch solutions at 34° by taka-diastase was determined by viscometric, copper reduction, polariscopic and iodometric methods. The rate of zymolysis of dextrin solutions by taka-diastase was also measured by the first two of these procedures. The viscometric method is much the simplest of the four and it is probably as accurate as the others, for the curves plotted from the results obtained by each of the methods are somewhat similar.

(2) The viscosity of 2·0% starch solutions was only slightly affected by changes of reaction from *p*H 3·0 to 9·0. Starch was partially precipitated at *p*H 1·0 and 2·0. The optimal reaction for the starch-liquefying activity of the taka-diastase was at *p*H 3·0 and the limits of activity were between *p*H 2·0 and *p*H 9·0 when determined with unbuffered starch solutions by the viscometric method at 34°. The optimum was at *p*H 4·0 when the starch solutions were buffered with N/2 universal buffer. The amylase was completely destroyed at *p*H 1·0 and 2·0 with unbuffered starch and at *p*H 2·0 and 3·0 with

starch buffered with N/2 universal buffer. The optimal *p*H for amylase both with unbuffered and buffered starch was close to the reaction at which the enzyme was destroyed. —B.C.I.R.A.

Starch: Constitution. A. Pictet. *Helv. Chim. Acta.*, 1926, **9**, 33-37.

The author demonstrates a linear relationship between the molecular optical rotatory power of degradation products of starch (namely, di-, tri-, tetra-, and hexa-hexosan) and their "coefficients of polymerisation." His conclusions are summarised as follows: Among the products of degradation of starch (the mass comprises "soluble starch") there exists one of simpler chemical structure than the others and having a specific rotation of about +189°. Assuming that the same relation exists between the rotatory power and molecular weight as for the ultimate products of degradation it is possible to assign to this compound a molecular weight of 2975 which is very near that required by the forumla $(C_6H_{10}O_5)_{18}$, in which case the simplest molecule of soluble starch is constituted by the condensation of three molecules of hexa-hexosan $(C_6H_{10}O_5)_6$. For the $(C_6H_{10}O_5)_{18}$ compound the author would reserve the term "molecule." The curve connecting the molecular rotatory power of this substance with those of all its depolymerisation products remains constantly linear. The necessary consequence appears to be that the successive condensations of the hexosan groups are effected from one end to the other of the series by the same agencies; any irregularities would be apparent on the curve. The author concludes that soluble starch comprises free molecules of the formula $(C_6H_{10}O_5)_{18}$ in which all the atoms are linked chemically by their ordinary valencies but that it can well be that associated molecules are also present, such as are perhaps existent in starch itself. —B.C.I.R.A.

Sizing. *Cotton*, 1926, **90**, 796-798.

As a result of practical tests in four mills the amount of solid material taken up from size by yarn is stated at approximately 88·5, 75, 80-85, 90 and 81% of the amount put into the size-mixing. The losses are accounted for chiefly by the loss of the moisture content of the ingredients. In one set of tests the difference between the percentage loss and the percentage of moisture lost by evaporation was found to be 18·9—15·9=3% and this is accounted for by one or more of the following—The sized yarn delivered by the slasher contains an additional amount of size required for the 1-3% of stretch which is obtained at the slasher. The yarn delivered by the slasher may contain less moisture than the yarn on the section beams, in which case the difference is made up by size. There is a slight loss by chafing at the slasher. The weight of the loom beams is generally on the heavy side. The author concludes that the solids put into the size mixing lose only that amount which corresponds to their moisture content. —B.C.I.R.A.

Warp Yarn: Sizing. P. Seydel. *Cotton*, 1926, **90**, 970-971.

A general article indicating the properties required of a good size. —B.C.I.R.A.

Algin: Properties of——. M. Deschiens. *Chim. et. Ind.*, 1926, **15**, 149T-154T.

In a review of the cellulosic and other products obtainable from algæ and other marine plants the author enumerates the properties, uses, and suggested uses of algin—as a sizing material, as impregnating material for protecting sacks from acid, as a defecating agent in sugar-refining and in confectionery, &c. The price of the product militates against its use and the author urges that capital and research should be applied to building up a French sea-weed industry. —B.C.I.R.A.

"Sichel" Cold Size: Application. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 327.

In an article on sizing the author discusses a number of causes of failure, such as unsuitable water, unsuitability in sizing machine rolls and roll pressure, wrong concentration and consistency of prepared sizes, &c. Good sizing properties are claimed for "Sichel" cold size, a proprietary article which contains adhesive, softener, and antiseptic. It is readily soluble in cold water, it remains of uniform consistency and does not form a skin on the surface. —B.C.I.R.A.

Sizing Serum: Properties. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 224, 251.

This is a proprietary article which has a vogue in Germany as a potato starch liquefying agent. Some claim that it makes a clear, penetrative size with less starch and fat. Another report says that it contains 45% of common salt, 35% of soda, and 20% of tetralin, and costs far more than the ingredients are worth. In the proportion recommended by the vendors, the starch would receive only 0·15% of soda, the effect of which would be insignificant. —B.C.I.R.A.

The Sizing of Silk as Applied to Ribbons. I. Ginsberg. *Silk* (N.Y.), 1926, **19**, No. 3, p. 34.

Sizing after bleaching and dyeing demands great care in selection of materials. It is not desired to effect any change in the feel or appearance of the fabric. Soluble starch, that is, starch treated with "Activin," has very favourable sizing properties. It may be easily made or may be bought on the market. Dextrin is another useful sizing material. —F.G.P.

The Sizing of Silk as Applied to Ribbons. II. I. Ginsberg. *Silk* (N.Y.), 1926, **19**, No. 4, p. 41.

It is maintained that many manufacturers think that less attention need be paid to the

sizing of cheap ribbons than to the better qualities. This is entirely wrong. The ribbon from the dyehouse is given a preliminary sizing in water, vegetable glue, and dextrin, and then passed between squeeze rollers and dried. This keeps it flat and makes subsequent work easier. The ribbon is then worked on the gumming machine through warm water and glycerine or spermaceti to improve the feel and give it a gloss. The fine satiny appearance thus obtained cannot be produced in the calender. If the ribbon is to be sized on both sides it is again put through rollers. Very little size is needed; the more size is used the poorer the look of the ribbon. A recommended sizing bath is—10 l. tragasol, 20 l. potato starch paste, 4 l. vegetable size, ½ l. rosin milk cooked together and when cooled add ¼ kg. soap and ¼ kg. coconut oil boiled in 2 l. water. The whole to be thoroughly mixed.
—F.G.P.

Artificial Silk: Sizing. W. Bennett. *Silk J.*, 1926, **2**, No. 24, pp. 61-63.
A general article on the ingredients used in sizing artificial silks. Directions are given for making up starch, gelatin, natural gum, and Rayonal sizes. Rayonal is a chemically treated starch. Its solution is perfectly clear and remains so on standing. A film is transparent, has a fair amount of elasticity, does not contract on drying to the same extent as most substances, is a very strong adhesive and has a high resistance to friction. —B.C.I.R.A.

Artificial Silk: Sizing. W. Bennett. *Silk J.*, 1926, **3**, No. 25, p. 62.
In a general article on artificial silk sizing notes are given on hank sizing by hand and on the machine, bobbin sizing, and sizing on the beam. It is advisable not to use boiling or even hot solutions; sizing at nearly normal temperature is recommended. In thin size mixtures dressing or brushing is not necessary. —B.C.I.R.A.

(C)—Weaving

Artificial Silk: Weaving. R. Hünlich. *Kunstseide*, 1926, **8**, 148-149.
The application of artificial silk in weaving is discussed. A plain calico-weave is general, and for this a simple eccentric loom is recommended because of its higher working speed. For fabrics of one colour a loom without automatic shuttle-changing mechanism is recommended, again because of more rapid working and consequent cheapness of product. The many slight modifications to be made in the working parts of an ordinary cotton loom to adapt it to artificial silk weaving are described.
—B.C.I.R.A.

Artificial Silk Decorative Fabrics: Weaving. *Kunstseide*, 1926, **8**, 67-68, 85-88, 113-115, 142-144, 177-180.
A series of articles on the application of artificial silk in weaving relate to the weaving of furnishing materials, tapestries, brocaded velvets, and damasks. Directions are given for weaving lampas fabric in which the pattern is restricted to the artificial silk warp and is visible only on the right side. The incorporation of artificial silk as pile warp in velvet and in the weft of light furnishing decorative materials, borders, &c., with cotton warp is treated in detail. In conclusion, the possibility of weaving true damasks in artificial silk is discussed with a full description of the pendulum damask machine of Gunther.
—B.C.I.R.A.

Fielden Ondulé Motion. H. Nisbet. *Silk J.*, 1926, **3**, No. 25, p. 63.
An Ondulé motion for the development of woven warp Ondulé effects in artificial silk fabrics is described. These effects are characterised by a series of uniformly wavy lines or stripes that may be developed in the direction either of the warp threads or of the weft, and are formed by means of specially constructed reeds known as "paquet" and "fan" reeds which assume a variety of patterns and in which the dents are inclined at varying angles and in reverse directions according to the particular effect desired in the cloth. The special function therefore of the Ondulé motion is to impart to such reeds a slow vertical and reciprocal traversing movement with the object of displacing the warp threads from their normal straight course. The way in which a Lancashire loom provided with a Climax dobby can be equipped with an ondulé motion is described in detail.
—B.C.I.R.A.

Artificial Silk Ribbon: Weaving. A. L. Wykes. *Silk J.*, 1926, **3**, No. 27, 64-67.
Some general notes on smallware weaving in artificial silk, with particular reference to the Saurer high speed loom.
—B.C.I.R.A.

Harness Adjusting Device. R. N. Reynolds and T. F. Dougherty. *Cotton*, 1926, **90**, 814.
The device consists essentially of a clamp of carbon steel which is fixed to a short portion of the harness strap, eliminating the loop at the lower end of the strap and the holes in the strap. It is claimed that with the device the harness can be adjusted when the warp is tied on and will remain in proper and positive adjustment until the warp runs out. In the case of the jack strap the use of the leather is eliminated entirely. Two companion bars are used having co-acting inclined teeth at the overlapped ends, and at each end hooks with which to connect them to the treadle and jack stick. The overlapped ends are recived in the clamp device and adjustment is made. —B.C.I.R.A.

Madras Handkerchiefs: Weaving. D. M. Amalsad. *Indian Text. J.*, 1926, **36**, 273-275.
An account of the present position of the Madras handkerchief and lungee industry.

The methods of warp preparation, weaving, and dyeing are described and marketing conditions are outlined. The recent deterioration in the hand-loom article is contributing to the noticeable gain in ground of the machine-made handkerchief. —B.C.I.R.A.

Healds: Properties and Threading. J. Funke. *Melliand's Textilber.*, 1925, **6**, 816-818.

A general article. —B.C.I.R.A.

Cam and Bowl Picking Motion; Theory of——. O. Thiering. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 233-234.

The author examines mathematically the practical view that the stroke in an over-pick loom is strengthened if the picking bowl is set higher on the picking shaft, and shows to what extent the practical view is correct. —B.C.I.R.A.

A New Loom Specially Designed for Rayon and Silk Weaving. *Silk J.*, 1926, **2**, No. 22, p. 65.

The special feature of the loom described is the take-up motion, which is absolutely positive and can be regulated to the finest limits of accuracy, pawls and ratchets being dispensed with. Increase in the diameter of the cloth roller automatically adjusts the take-up, which is controlled from start to fell. Perfection in shuttling is aimed at by machining the going part. The warp beam is very robust in construction to avoid vibration. The loom has under-pick motion and a special shuttle catching motion; as many as four shuttles can be used. Other advantages are described. The motor is incorporated in the design. —F.G.P.

Artificial Silk Fabrics and Causes of Reediness. *Text. Argus*, 1926, **3**, 20th Oct., p. 4.

Artificial silk yarns do not "cover" so fully as do natural silk yarns, and for production of fabric having satisfactory fullness and compactness it is necessary to use 10-20% more ends or picks than is required with natural silk. Artificial silk yarns cover better as the denier of the individual fibres is decreased. Artificial silk warps usually contain an unusually large number of knots and consequent reediness may be avoided by using the largest possible mails and slays having coarse denting. Reediness is decreased by increasing the period of "dwell" of the loom tappets, although strain on the warp is thereby increased. Raising of the back-rest of a loom and thereby slightly slackening the top shed assists the production of artificial silk fabrics free from reediness. —A.J.H.

Warp Tension Regulator. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 221.

A safety device is described for preventing the appearance of transverse streaks in a fabric woven from a light coloured warp and a dark weft. These weft faults are caused by irregularities in the weft material and by stoppage of the loom for weft repair or breakage. The device consists in a compensating warp tension regulator which takes the form of a rod, supported between the back rail and the warp beam, to the ends of which are attached springs fixed at the other ends. —B.C.I.R.A.

Damask Fabrics: Weaving. A. Hamann. *Melliand's Textilber.*, 1926, **7**, 130-132, 217-218, 305-307, 413-417, 506-509.

The weaving of figured materials such as damask tablecloths, serviettes and handkerchiefs is discussed. Point paper diagrams of the common weaves employed are reproduced and explained and the preparation of such diagrams for any given design is discussed with reference to five designs, patterns of which are provided and for which the corresponding point paper diagrams are worked out. —B.C.I.R.A.

Loom Designing. See Section 5.

(D)—Knitting

Random Coloured Artificial Silk Hosiery: Knitting. W. Davis. *Silk J.*, 1926, **3**, No. 26, 62-63.

The production of random effects in artificial silk hosiery by the action of irregular and very slight twist on two yarns which are employed in the same thread guide of the knitting machine is discussed. —B.C.I.R.A.

A New Non-laddering Fabric. *Silk J.*, 1926, **2**, No. 22, p. 58.

A special knotted stitch has been invented which not only makes laddering impossible but also enables the fabric to be cut and to preserve its shape. It can be made in silk, rayon, cotton, &c., has an open texture, remarkable elasticity, it uses less material than ordinary knitted or woven goods, it has good texture and feel, and its cost compares favourably with others. It has a French origin but is made on Swiss machines. The British rights have been secured and 40 looms have been started on it. —F.G.P.

Imitation Bobbin Lace Machines. W. Krumme. *Melliand's Textilber.*, 1925, **6**, 901-904.

An account of the development of modern machines for making imitation bobbin laces. These machines were developed on the principle of the braiding machine and not on a loom principle. —B.C.I.R.A.

(G)—Fabrics

Staple Artificial Fibres: Application. *Silk J.*, 1926, **3**, No. 25, p. 69.

Notes on some exhibited fabrics made from staple artificial silk fibres including "Vistra," "Sniafil," and a cuprammonium staple fibre made by the Foltzer process.

The fabrics include velvets, plushes, furnishing fabrics, fleecy-knitted and atlas fabrics, &c. —B.C.I.R.A.

Rayon in Combination with Wool Textiles. "Tindairns." *Silk J.*, 1925, **2**, No. 14, p. 55.

Rayon is produced in tops and blended with wool tops through the gill boxes, the best yarn being made on the self-acting mule. Mixtures with wool twist and worsted twist are popular; additional variety is obtained by introducing a cotton thread. Figured and semi-figured fabrics are in demand, the mixture being introduced as an extra in warp or weft, or as warp or weft. Chardonnet or Tubize rayon is not greatly used in England; viscose, Celanese, and Brysilka being the main supplies. Details of the weaves of several fabrics are supplied. Viscose may be processed as if it were cotton. —F.G.P.

Synthetic Fibres in the Wool Industry. *Text. Argus*, 1926, Oct. 6th, p. 4.

A discussion of the inroads of artificial silks in the wool industry particularly in the manufacture of knit goods, linings, crêpe-like printed fabrics and pile fabrics. —A.J.H.

Fabrics: Nomenclature and Weaving. O. Kuhn. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 86-88, 171-173, 221-222, 302.

Further articles deal with the weaving of (1) Jacquard gauzes, (2) pile fabrics including velvets and plushes, plain and figured, astrakans, &c., (3) tapestries, gobelin imitations, &c. —B.C.I.R.A.

Crêpe Romaine. J. Chittick. *Silk* (N.Y.), 1926, **19**, No. 3, p. 37.

This fabric resembles a basket-weave crêpe georgette; it drapes well and wears well. Both warp and weft are hard twist silk, 3-6 threads of 13/15 den., with 50/55 to 70/75 twists per inch. Two warp threads and two picks work in concert, thus giving an open weave. The hard twist gives a rough feel to the cloth and prevents slipping. The heavy twist is expensive and slow to produce. A typical weave is 45½ in. on loom, to give 40 in. cloth. Yarn for warp and weft might be 5-thread with 50-60 turns, warped 2 right and 2 left alternately; the shoot would have 112 picks to the inch, also 2 right and 2 left. The shrinkage would give 135 ends and 120 picks per inch. The cloth would weigh about 2½ oz. per yard finished; finishing deducts about 7% from the woven length. Dyeing and finishing are easy, but sometimes greater smoothness is given by calendering. —F.G.P.

Tulle: Weaving. M. Böhmer. *Melliand's Textilber.*, 1926, **7**, 509-512.

Five types of tulle differing in mesh from ordiary tulle are illustrated and the methods of producing these modifications are described. —B.C.I.R.A.

PATENTS

Automatic Unwinding of Warp. Société Bruyère et Banzet. F.P.596,776.

A support fixed upon a side of the loom or upon a gantry bearing the beam comprises a steady sleeve through which runs the shaft driving the beam to which it is bound by a rigid plate with driving fingers. The whole of these, constituting the unwinding system, is mounted to oscillate freely on the sleeve and counterbalanced by the sheet of warp with counterweights or springs. —Bur. Text.

Driving of the Workers in Raising Machines. A. Michalot et Sirot. F.P.597,123.

In this machine the workers, pile and counterpile, are free and are driven by the cloth itself which is drawn out at a predetermined speed. All the workers are mounted loosely on the drum of the machine and they are double the ordinary length, to give room to mount on each two sets of wires, one for the working of the pile and the other for the counterpile. —Bur. Text.

Swinging Motion of the Reed. Camille Seynaeve. F.P.597,559.

The locking of the reed, i.e., its wedging in the slay, is obtained by means of oscillating levels which are rendered motionless by a bolting bar provided with bolts which is put into action only when a catch mounted upon the shaft, bearing oscillating levels, runs into a buffer fixed upon the fore bearing of the loom, just at the moment when the slay comes to the bottom of its course and the reed consequently beats up the weft. —Bur. Text.

Lace Machine Patterning Mechanism. C. Bilhartz, Strasbourg, France. E.P. 252,358.

Tulle, traverse net, braids, &c., are made on a machine provided with two series of bobbins mounted in carriages which move in comb bars capable of being traversed by pattern wheels. The carriages are pushed across the space between the bars by the direct action of jacquard cards or bars on thrust bars. These cards are fitted in longitudinal grooves of drums to which a sliding and turning movement is imparted by cam wheels and intermittent gearing. The drums may be arranged either so as to move towards or from each other simultaneously or so that the two move always in the same direction. The pattern wheels are provided with radial rows of holes in which are mounted removable rollers which shog the comb bars distances corresponding to the radial displacement of the rollers. The pattern wheels are driven by intermittent gearing. Warp and weft threads may be worked into the fabric. —B.C.I.R.A.

Looms: Warp Letting-off Motion. J. W. Booth and T. C. Corlass, Keighley. E.P.253,969.

The detector acting on the warp is mounted on a vertical rack gearing with a pinion

on a shaft having a pinion engaging a horizontal rack actuated by a spring and connected by a rod to the usual weight on the horizontal arm of a bell crank lever, the vertical arm of which is connected by a rod or chain, a pulley, and lever mechanism to the brake blocks or chains. As the diameter of the warp on the beam decreases, the detector, which may comprise rollers, is forced upwards by the action of the spring and the weight is moved nearer to the pivot to the bell crank lever. The bearings for the shaft are supported by a bracket that can slide over a separate bracket on the lower rail. The rod connected to the chain is carried by a screw whereby its distance from the pivot of the bell crank lever may be varied.
—B.C.I.R.A.

Parallel Knitting Machine: Colour Knitting Attachment. C. Heimgartner, Zurich, Switzerland. E.P.254,182.

For knitting on the front bed in two colours by pattern wheels an attachment is employed by means of which half as many colour courses can be made as there are courses made on the rear needles. For colour knitting the needle butts are sorted out by cams and the pattern wheel into alternate groups of three and four arranged in staggered formation, the groups of three drawing loops and completing stitches. On the return movement the remaining needles pass over a heel on the attachment and draw loops which are converted into stitches in the same course. The whole of the front needles thus complete a course while the rear needles are making two courses, by the aid of a single pattern wheel. A number of interchangeable pattern wheels are mounted on a device which is turned by hand to change the pattern as required. Each wheel is mounted on a short shaft parallel to the needles which gear with a toothed wheel on the same shaft when the pattern wheel is in action. —B.C.I.R.A.

Loom Weft Replenishing Mechanism. Maschinenfabrik Rüti vorm. C. Honegger, Zurich, Switzerland. E.P. 254,325.

Pointed and blunt weft-feeler needles are mounted on a holder which is pivotally and adjustably mounted on a spring-pressed lever. The blunt needle bears on the body of the weft, while the pointed needle is opposite the conical end thereof, so that it does not pierce the weft until it is nearly exhausted. The needles coact either with a slotted cop-case having internal winding-off or an ordinary cop having longitudinal slots under the windings. The needle holder also carries a dagger. The spring-pressed lever is oscillated by the impact of the lay on its arm, while the dagger is normally raised by the impact of the blunt needle on the weft. When the weft is substantially exhausted the pointed needle pierces the remaining windings, and the dagger oscillates an arm on a shaft against a spring. A cam plate on the shaft thereupon actuates an arm to stop the loom or to initiate weft replenishment. —B.C.I.R.A.

Embroidery Machine Needle Mechanism. F. J. Gahlert, Barenstein, near Chemnitz, and M. Bretschneider, Plauen, Vogtland, both in Germany. E.P. 254,374.

The jacquard needles are carried by pairs of separately slidable plates having slots therein which engage and communicate movement alternating in opposite directions to pairs of levers, pivotally mounted on a shaft and actuating sun wheels freely mounted on the shaft which in turn actuate lever-carried planet wheels geared to a terminal gear member by which the summation of the movements produced by the various jacquard needles is transmitted to a work-frame. A set of work frames for embroidery machines may be actuated in parallel by connecting the work frames to a bar of a parallel linkage actuated by the jacquard mechanism. —B.C.I.R.A.

Loom: Change Box Motion. A. Livesey, Blackburn. E.P.254,448.

The drop boxes are controlled by a rod connected by a spring to a second rod on a lever which is operated by a connecting rod on the stud of a toothed dog wheel. This is turned to change the boxes by the teeth of a gear wheel rotating with but slidable on the tappet shaft, the rotating wheel being moved into position to engage the dog wheel by a bell crank lever operated by a rod from an indicator lever. The action of the indicator lever is governed by the pattern disc or wheel and the bell crank lever and rod are operated against spring action and the boxes are changed.
—B.C.I.R.A.

Circular Rib Knitting Machine. A. Biernatzki, Chemnitz, Germany. E.P. 254,461.

Lengths of fabric consisting in part of one-and-one rib and in part of two-and-two rib fabric are made continuously on a circular rib machine with separating rows between. These lengths may be used as spats, short sleeves, &c. Both the cylinder and dial needles are arranged one with a short heel and two with long heels alternately. The cylinder and dial knitting cams are both in two parts, one member of each pair being adjustable. With one position of the adjustable members, all the needles are actuated and one-and-one rib is knitted. In the alternative position only, the long-heeled needles knit to form two-and-two rib fabric. When the separating row is to be made a cylinder cam is raised to cause all the cylinder needles to shed their loops; at the same time the short-heeled needles are caused to shed their loops while the long-heeled needles knit the separating row. —B.C.I.R.A.

Jacquard Card Punch Guide. A. McMurdo, L. Morrell, and McMurdo, Ltd., Miles Platting, near Manchester. E.P.254,536.

A card guide for a punching machine for jacquard cards comprises two guide-blocks adjustable on a right and left-handed screwed rod to equal distances on either side of the centre line of the punches. Guide plates are fixedly or resiliently mounted on the guide-blocks. Any other single adjusting member for the guide blocks may be used. —B.C.I.R.A.

Looms: Warp Beam. D. McKill (Albert Engineering Co.), Rochdale. E.P. 254,537.

A beam or bobbin for textile machinery comprises one or more sections mounted on a spindle and clamped between end flanges secured by washers, and nuts which are enclosed or shrouded by ruffles on the spindle. The flanges are fixed to the barrel by screws. —B.C.I.R.A.

Looms: Automatic Shuttle-changing Mechanism. K. Toyoda, Nagoya, Japan. E.P.254,662.

The front and back plates of the shuttle box of an automatic shuttle-changing loom are mounted on a common rocker arm, the front portion of the front plate having a cam face. A shuttle guide plate is pivoted on the lay and is normally in an inclined position under the action of a spring. When the weft is exhausted or broken, an arm is raised and in turn raises a bunter arm into the path of a lug on the lay. As the lay beats up, the bunter arm is forced forward to rock arms on a shaft and push forward a pusher rod. The rod advances the lowest shuttle in the magazine between the cam face on the front plate and the shuttle guide plate which are forced apart to a horizontal position against their springs. The front and back plates are thereby raised to allow shuttle S_1 to enter the box and force out the used shuttle S on to a receiving plate carried by the back plate and against a stop on the lay. The front and back plates then return to normal position and the shuttle S is discharged. —B.C.I.R.A.

Looms: Shuttle Magazine Stop Device. K. Toyoda, Nagoya, Japan. E.P.254,663.

To ensure that full shuttles are correctly inscribed into the supply magazine, interconnected levers are pivoted in the wall of the magazine. If a shuttle is correctly inserted it forces out the levers against springs and so removes the projections on the levers from its path. If a shuttle is put in on its side it does not actuate the levers and is therefore held up by the projections. —B.C.I.R.A.

Silk Oil Dressings (Sizes): Composition. A. F. Galvin, Villerbaune, Rhône, France. E.P.254,720.

Sizes for textile fibres which are not sufficiently acid to burn the fibres and are completely removed in the degreasing or boiling operations, comprise a refined oil with a relatively small quantity of a drier boiled in linseed oil. Suitable driers are stated to be a drier acetate or resinate, or cobalt oleate. In an example, a size comprises 2 litres of petrol or benzine, 1 litre of refined oil or extra light drier, 1-10 litres of soap, benzine, light mineral oil, vaseline oil, or olive oil, 30 grams of grease, lanoline, or tallow, 30 grams of pure wax or Japan wax and optionally 1-2 litres of china wood oil. Certain silks may be first treated with a solution of glue, dextrine, casein, baked starch gelatine, or a gum and in certain cases the fibres, after sizing, may be treated in a softening bath of either olive oil, castor oil, or mineral oil, or of benzine soap, grease, lanoline, tallow, or dilute Japan wax in petrol or benzine. —B.C.I.R.A.

Parallel Knitting Machine Patterning Mechanism. E. C. R. Marks, London (for S. Broadwin, U.S.A.). E.P.254,775.

In an attachment to one or both beds of a flat plain knitting machine to convert the same into a jacquard machine as required, consisting of a set of needle-lifting jacks, a jack lifting and lowering cam adjustably mounted on the usual cam-assemblage, and jacquard means operable at each knitting operation to raise selected jacks into the path of movement of the cam so that corresponding needles produce design stitches, an endless flexible perforated pattern strip selects the jacks. The action of the strip is detailed. —B.C.I.R.A.

Artificial Silk Sizing Machine Pressure Roller. Courtaulds, Ltd., London, and C. F. Topham, Coventry. E.P.254,866.

In apparatus for sizing textile materials such as threads or fibres, more particularly artificial silk, in which the threads are led from a roller, between a sizing roller and pressure roller, over a heated plate, and thence through a reed to a warping beam, the pressure roller is formed of a central spindle surrounded by a rubber or other resilient cylinder, the space between the spindle and cylinder being partially filled with a liquid such as water. The sizing and pressure rollers may both be positively driven or the pressure roller may be driven by friction from the sizing roller. In a modification, the central part of the spindle is cut away, the roller being driven from both ends. —B.C.I.R.A.

Circular Knitting Machine Cam Box: Description. J. Robinson, Leicester. E.P.254,871.

The top cam box of a machine with two stationary needle cylinders is provided with a flange which rests on a seating of a bracket mounted on a post. The bracket has a slide face fitting in guide-ways on lugs and is supported by an adjustable

screw. The cam boxes are removably connected by a post, arm, and forked block. —B.C.I.R.A.

Loom Picking Motion: Description. J. T. Lobley, Blackpool. E.P.254,885.

Details are given of cam-controlled lever mechanism for operating, without the use of a picking stick or shaft, reciprocating pickers carrying resilient blocks for striking the shuttle and sliding along a spindle or rod mounted below the shuttle box. Shuttle and picker checking mechanism is described. —B.C.I.R.A.

Jacquard Comber Board: Description. J. G. N. Brown and J. Kerr, Portadown. E.P.254,927.

The comber board has removable splits or slips supported in slots in bars attached to the side members of a rectangular frame. The slots are made to the finest pitch that will be required. Spacer splits are used at the ends and centre, &c., and are furnished with holes to receive wires. The splits have projecting pins extending across the back of the bars to prevent displacement thereof. Cover strips retain the splits in position. The setting of the comber board may be varied by removing the strips and closing up or opening out the splits. In modifications the slotted bars are replaced by bars having removable pegs, or by bars having slots to receive a series of alternately long and short pegs clamped in position by end screws. —B.C.I.R.A.

Braiding Machine: Description. A. E. White, London (for American Wiremold Co.). E.P.254,932 and 254,933.

The inner yarn masses are disposed transversely to the radius of the machine to allow their size to be increased for a given radius while reducing the overall dimensions of the machine. Each inner carrier comprises an elongated hollow frame supported at the inner ends by rollers and at the outer ends by shoes bearing in or against a groove or depression in a rotary drum. The carriers are driven in the opposite direction to the drum by means of a frame carrying bearings for radial shafts the inner ends of which carry bevel gears meshing with a fixed annular rack. The outer ends carry notched steel discs which engage concave bearing surfaces of blocks. The shoes and blocks may be of oil-treated wood. Notches allow the strands of yarn from the outer carriers to pass through the drive without injury. The block and disc may be mounted otherwise than at the outer end of the carrier. —B.C.I.R.A.

Parallel Knitting Machine Patterning Mechanism. G. Bell, Preston, E. O., F. V., and W. Donner, Kilmarnock. E.P. 255,135.

To facilitate the production of raised designs in tuck or other stitches one stitch cam is made in two parts which may be forced apart, against spring pressure, by the butts of selected needles, &c., as they follow an indicated course. One part is connected by a spring to a stud on the cam plate and by a spring to the other part. The needles are selected mechanically or by hand. The parts are cut away and rounded at their leading-in edges to facilitate the entry of the butts. —B.C.I.R.A.

Pile Fabric Loom. D. and T. H. Crabtree, Laisterdyke, Bradford. E.P.255,200.

The pile is formed by means of hooked rods or bars, mounted side by side on a rack bar fixed to a sliding bar which is caused by cam controlled lever mechanism to move on the breast beam and thus move the rods, &c., towards and away from the reed. The upper edges of the non-hooked parts of the hooked rods, &c., are engaged by a grooved upper bar which is caused to slide longitudinally on the rack bar at times to tilt the rods from vertical to inclined positions when the rods have been moved towards the reed, thus enabling the hooked parts of the rods, &c., to engage the warp threads and cause them to form loops over the rods as these move away from the reed. The loops slide over the rods as the wefts are beaten up and ultimately are cut by the lower edges of detachable cutting blades held in grooves in the rods by cross-pins or by the upper edges of cutting blades embedded in the rods. —B.C.I.R.A.

Shuttle Checking Mechanism and Stop Motion. F. Fisher, Sowerby Bridge, Yorkshire. E.P.255,208.

The cranked end of a swell is resiliently secured upon an integral stud portion of a bracket secured to the shuttle-box back, the swell projecting into the shuttle box to act on the shuttle in such a manner that the greater part of the shuttle is brought into contact with the straight part of the swell and the shuttle box back. The stud passes freely through an aperture in the cranked portion of the swell and is provided with an adjustable spring resting in a recess in the swell. In some cases, an adjustable curved blade spring secured to a bracket on the shuttle box and resting on the cranked portion of the swell is used in place of the spiral spring. A blade spring secured to the stud and resting on the middle portion of the swell is provided to prevent vibration. The inner part of the cranked end of the swell is curved for bearing on the bracket when the shuttle is not in the box. Rebound of the picker is prevented by its engagement by the swell. The free end of the swell engages a stop-rod finger. —B.C.I.R.A.

Circular Knitting Machine. T. S. Grieve, Leicester. E.P.255,210.

Circular machines of the superposed-cylinder type are provided with means for effecting a ready separation of the cylinders whereby access to and removal of the sinkers is facilitated. The top cylinder and

cam box are carried by an annular flanged plate fitting in an opening in the top plate. The cylinder is attached to a bearer mounted on ball bearings and keyed on a pin screwed into the upper ball race. The cam box is attached to the flanged plate by screws and the plate is held in the top plate by movable clamps and by pins engaging peripheral notches. When it is desired to have access to the sinkers the flanged plate is raised until the notches are clear of the pins and is then turned slightly so that the pins support it and the cylinder, &c. The upper part of the sinker cam is attached to a shouldered sleeve fitting in a sleeve to which the lower part of the cam is attached. Normally the sleeves are held together by a screwed sleeve which is unscrewed to allow the shouldered sleeve to be raised to release the sinkers. —B.C.I.R.A.

Pile Fabric Loom Pile Wire. T. Twigg, Kidderminster. E.P.255,304.

The pile wire has a recess to receive a detachable cutting blade which is held in a position by the engagement of a projection under a part formed by making an L-shaped slit in one wall of the recess and bending in the tongue of metal thus formed. The projection may wedge in the curved part of the recess and the rear edge of the blade may abut under the formed part. —B.C.I.R.A.

Loom Weft-replenishing Mechanism. R. Crompton, Worcester, Mass. E.P. 255,383.

In looms in which the weft carriers are automatically transferred, the transference is made at measured intervals irrespective of the amounts of the remnants of weft remaining thereon, the ends of the remnants being subsequently secured to new supplies and the weft carriers being rewound with lengths of new weft corresponding to the amounts removed therefrom. A measuring device acting to effect transfer after a certain number of picks or a clockwork device may be used to determine the intervals. The amounts successively rewound on to a weft carrier may be varied so as to prevent the formation of a succession of knots in the weft remaining on the weft carrier. —B.C.I.R.A.

Loom Dobby Mechanism. F. and A. Fielden, Heaton Moor, near Manchester. E.P.255,393.

The draw knives of loom dobbies are connected to the draw rods by swivel bearings located in the chambered-out ends of the rods. The bearing comprises rectangular ends which are removably and rotatably mounted in the bifurcated end of a screwed rod, adjustably fixed in the chambered-end of the draw rod. The other end of the draw rod is adjustably pivoted to the draw lever. —B.C.I.R.A.

Shuttle Checking Mechanism. A. Bachmann and A. W. Graf, Zurich, Switzerland. E.P.255,408.

On entering the box, the shuttle receives a preliminary check from one or more auxiliary brakes or swells additional to the ordinary swell. The swell extends through a slot in the shuttle box flap or wall and is carried by a lever. It is also connected by a shank and rod to a bell crank lever on a shaft acted upon by a spring the tension of which can be adjusted by turning a head. The extent to which the swell projects inwards can be adjusted by a set screw. Before the shuttle is ejected, the loom connecting rod acts on a cranked pin adjustable on the bell crank lever, which is thereby turned so that the auxiliary swell is withdrawn. A modification is described in which a second auxiliary swell projects through the front wall of the shuttle box and is connected by lever mechanism to the first auxiliary swell. In another modification the bell crank lever actuates another bell crank lever connected to the auxiliary swell. —B.C.I.R.A.

Unwoven Textile Fabric. E. Weinheim, New York. E.P.255,476.

Unwoven textile fabrics are made by forming a web of fibres, applying a binder, applying fibres at an angle to the fibres of the web with a further quantity of binder, and pressing the fabric so formed. A carding machine delivers fibres on to a belt forming a uniform layer which passes under a container delivering the binder through a series of fine orifices. The web passes through a drying chamber in which the binder sets or is dried, between rollers and to a winding drum, driven peripherally so that the fabric is wound at a constant linear speed. To apply a transverse layer of fibres the fabric passes from the drum under a distributor adapted to be moved to and fro across the run of the fabric on guide rails and to discharge an emulsion containing textile fibres on to the fabric through fine jets. These fibres are laid transversely of the fabric by the motion of the distributor. Alternatively, separate rectangular pieces of fabric may be applied by apparatus similar to the feeder of a printing machine. —B.C.I.R.A.

Loom Change Box Motion. A. Barbier, Lyons, France. E.P.255,669.

Each freely rotatable satellite pinion in the drop box motion of Specification 252,286 is provided with two holes, and a spring-contrôlled pin carried in a part keyed to a sleeve, &c., on the spindle or shaft is caused to engage one or the other of these holes, to cause a rise or fall respectively of the boxes. —B.C.I.R.A.

Elastic Fabric: Construction. O. & C. Ansonia & Co., Ansonia, Conn., U.S.A. E.P.255,814.

Elastic webbing is woven with covered rubber cords and other warp threads

arranged in units, each comprising two cords, two fine binder warp threads, and four coarse stuffer warps, intersecting with weft threads repeating after each ten picks. The cords are situated one above the other. Two picks pass over the warp cords and over the stuffer warps so as to lie on the top of the fabric, whilst two picks pass between the cords and the fifth pick below them. The face of the fabric is hard and has a reticulated appearance, whilst the back where the loosely woven coarse warps appear is soft. The selvages may be formed by covered rubber warp cords and fine binder warps. The cords may each comprise a rubber thread covered with two layers of cotton. The remaining threads may be of cotton. —B.C.I.R.A.

Artificial Silk Size: Composition. Neutrasol Products Corporation, New York. E.P.255,909.

To facilitate the working of artificial silk by the throwster, weaver, or knitter, and to enable finer yarns to be used, the filaments are caused to adhere together by the application of a coating which performs the functions of sericin in natural silk and which can easily be removed. A suitable composition is beeswax 3 parts, Japan wax 3½ parts, stearic acid 3½ parts, and oleic acid or red oil 1 part. These are melted together and intimately mixed. One part of caustic soda is dissolved in 20 parts of water and the solution mixed with the melted wax mixture. The product is applied in melted condition, either by the silk manufacturer or by the user of the yarn. Afterwards, the coating may be removed and the material left clean for dyeing by treating with water at 160° F., the caustic soda causing the saponification of the Japan wax, stearic acid and oil and the emulsification of the beeswax. The treatment may be applied to any textile fibre or yarn. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Weaving—

255,019. V. D. Popov. Device for driving and stopping looms automatically and rapidly.

255,852. P. de Guardia-Calmetes. Looms specially designed for reed fabrics.

Knitting—

254,458. M. and E. Neaum. Narrowing picker device.

4—CHEMICAL AND OTHER PROCESSES

(C)—Washing

Odours in Finished Fabrics. *Chem. Age*, 1926, **15**, No. 376 (supplt.), p. 24.

Unpleasant odours are commonly due to soap or oil. Amongst a batch of goods all treated apparently alike some pieces may be found to be odorous. If soaped goods are plunged into cold water, if a strong soap solution is used, or if the rinsing is insufficient, odours may arise. A good rinsing temperature is 110° F. Some soaps hang on in spite of good rinsing; such soaps should be avoided. Oils used on the yarn to facilitate weaving or throwing should be well washed out; cheap mixtures of oil cause extra expense for washing. —F.G.P.

(D)—Milling

Weighting Artificial Silks. W. Bruckhaus. *Chemicals* (N.Y.), 1926, **26**, No. 11, p. 22.

The object of weighting is to make rayon look like silk. Most of the experiments have been made with aluminium salts alone or combined with ordinary or sulphonated vegetable oils and consist of a precipitation on the fibre, generally after dyeing. The lustre is certainly dulled but the feel is spoiled. Barium sulphate is said to give much better results. The fabric is soaked in 2 or 3% sulphuric acid and without washing is passed through a bath of 3-5% barium chloride from 20-30 minutes. The rayon is dulled by this and may be dyed, when it is said to resemble silk to some extent. The dyebaths must not contain any sodium sulphate which would remove some of the barium sulphate and so check the dulling; apart from this the dyeing is normal. Yarn treated this way is said to be in perfect condition for weaving. The increase in weight is given as 3-5%. The tin phosphate-silicate method of weighting is stated to give good results and incidentally to increase the tensile strength. Viscose rayon of 120 den. was found to have increased in weight by 185%, compared with an Italian 19/21 den. silk which increased 169%, and a nitro-rayon, in three passes, increased 182%, compared with a Jap silk 161%. In both cases the rayon dyed well and gave rise to no difficulties in milling. —F.G.P.

(E)—Drying and Conditioning

Compartment Drying Chamber. W. A. Noel. *Chem. and Met. Eng.*, 1926, **33**, 480-482.

A six-chambered drying apparatus for vegetables is described. Heated air is continuously circulated by a blower fan through the drying compartments then through a port in the bottom into a return duct by which it is returned to the steam-heated radiators. Temperature control is effected by an indirect-acting duct of the intermediate or gradual movement type, giving a gradual motion to the valve in the steam line. The humidifying and de-humidifying of the air is effected by a set of dampers operated by hygrostat action on a diaphragm valve worked by compressed air. Details of construction are given. —B.C.I.R.A.

(G)—Bleaching

Lace: Bleaching and Finishing. *Amer. Dyestuff Rep.*, 1926, **15**, 459.

Cotton lace requires rather different treatment from other cotton fabrics because the firmness of structure and the hardness of the yarn make liquid penetration difficult. Bleaching is generally effected by boiling in 2½ to 3% caustic soda solution under pressure, care being taken in the packing and handling of the lace in the kier. After washing, the lace is starched with or without weighting agents. Suitable sizes contain sugar, corn starch, soluble thin starches and dextrin. Calcium sulphate and dolomite are the principal weighting agents. Boric acid, sodium fluoride, and beta-naphthol are recommended as mildew-proofing agents. —B.C.I.R.A.

Perborates; Catalytic Action of Copper and Iron Compounds in Bleaching and Washing with——. Y. Dalstrom. *Chem. Zentr.*, 1926, **2**, 507 (from *Svensk. Kem. Tidskr.*, **38**, 96-101).

The author concludes from numerous experiments that copper and iron compounds have no dangerous action on the fibre. In concentrated perborate solutions, however, copper and mixed copper and iron salts destroy the fibre while iron salts do no damage. The sodium salts of the fatty acids destroy the catalytic action of these metallic compounds so that in their presence the difference between the copper and iron in perborate solution disappears. The bleaching action ot a known amount of perborate is greater in the presence of a sodium fatty acid salt than in pure solution or in presence of soda. —L.I.R.A.

Artificial Silk Waste: Bleaching. Walter Kosche. *Melliand's Textilber.*, 1925, **6**, 827-828.

Directions are given for the pre-treatment, bleaching, and finishing of the four different types of artificial silk waste encountered in the trade. These include ordinary spinning process wastes, wastes from the single spinning bath process, wastes arising in the weaving processes and sweepings, &c., all requiring different treatment. —B.C.I.R.A.

Viscose Artificial Silk Waste: Bleaching. H. Hillringhaus. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 61-62.

Most viscose silk waste occurs in the course of manufacture before the sulphur-removal stage. For treating the waste a bath containing 10-12 gr. of sodium sulphide per litre at 45-50° is recommended; the waste is then washed and bleached with bleaching powder or sodium hypochlorite solution. After bleaching, the waste is again washed and may be dyed. Long standing in water does not rot viscose yarn. Satisfactory bleaches have been obtained with 120 den. yarns of 19 filaments each of 6·3 den. and others. —B.C.I.R.A.

Aktivin: A New Product for the Textile Industry. A. J. Hall. *Dyer and Calico Printer*, 1926, **56**, 150-151.

Aktivin (sodium *p*-toluenesulphochloramide) is an oxidising agent of the peroxide type but of much greater stability than sodium peroxide, perborate, or hydrogen peroxide. It is useful for bleaching textile materials, and because of its liquefying action on starch it finds application in the desizing of sized yarns and fabrics and also in the preparation of sizing and finishing pastes. —A.J.H.

(H)—Mercerising

Cellulose Mercerising Press. M. Hausser Co. *Silk J.*, 1926, **3**, No. 27, 74.

The press previously described can only be installed where there is sufficient height to allow operation of the overhead travelling crane. To meet restricted conditions a second type of machine has been introduced. The press is supplied with a delivery opening cut in the bottom of the steeping tank and provided with a drop lid. The opening and closing of the lid is facilitated by the use of balance weights. Closing is effected by a simple screw arrangement operated by a hand wheel and gearing. In operation, the cellulose is well soaked and pressed and the last remaining portion of caustic soda is run off into the end of the steeping tank near the press cylinder. After this, the lid is opened, a transport wagon is wheeled underneath, the movement of the press is reversed and the material dropped on the wagon. The mercerised cellulose is weighed on the wagon. —B.C.I.R A.

Cotton Cloth: Mercerisation. *Mech. Eng.*, 1926, **48**, 750.

In a discussion of a paper dealing with mercerisation, the author replied to questions concerning the lustre and shrinkage resulting from the process. —B.C.I.R.A.

(I)—Dyeing

Oil Soluble Aniline Colours. G. A. Prochazka. *Chemicals* (Dyestuff No.), 1926, **26**, No. 7, pp. 19-20.

An account of dyestuffs soluble in organic solvents, such as benzol and oils. —L.I.R.A.

Cotton and Cotton-Artificial Silk Stockings: Dyeing. W. Bruckhaus. *Kunstseide*, 1926, **8**, 180-182.

The conditions necessary to obtain good dyeing results on cotton and cotton-artificial silk mixture stockings are discussed. Yarns of uniform strength and twist and even mercerisation must be employed, and much depends on the dispersity of the dye. For the uniform dyeing of mercerised stockings a dye must be chosen which is taken up very slowly by the fibre. The dyes must further be resistant to organic acids and formaldehyde and be unaffected by higher temperatures, since the dyed stockings usually

undergo an acid treatment to render them silk-like in feel. The method of handling the stockings to avoid damage in the dyeing machine, particularly important for artificial silk in the wet state, is discussed.
—B.C.I.R.A.

Mordants from Waste Materials. E. T. Ellis. *Dyer and Cal. Printer*, 1926, **56**, 70-71.

A description of methods by which such substances as aluminium sulphate, copper nitrate and sulphate, copperas, and tin salts are prepared from waste products.
—A.J.H.

Cotton: Affinity for Dyes. P. Ruggli and S. M. Pestalozzi. *Helv. Chim. Acta.*, 1926, **9**, 364-378.

The paper is a study of the affinity of cotton for dyestuffs or other compounds and their chemical constitution. The authors measured under standard conditions the amount of dyestuff taken up by cotton (adsorption power) and the amount of dye stripped from the dyed sample by washing and soaking in water. The "affinity of cotton" is defined as the difference between the two values (dye adsorbed—dye stripped). A table of affinities of cotton for dehydro- thiotoluidine and primuline derivatives is given for dyeings with and without the addition of Glauber salts. The results show that the cotton affinity for (non-adsorbed) sodium dehydro-thiotoluidine sulphonate can be developed step by step by appropriate substitution or condensation. The cotton affinity of the dehydrothiotoluidine-primuline class is low in comparison with that of the benzidine dyestuffs. The products dyed with Glauber salts are the more readily stripped by water. Monazo dyes derived from primuline are more firmly fixed on the fibre than those from dehydro-thiotoluidine but the difference is not large. Erica which is known to be highly dispersed is correspondingly readily stripped by water. It was not possible to establish cotton affinity as a characteristic constant since the degree of dispersity, as influenced by chemical structure, appears to be the determinative factor. —B.C.I.R.A.

Optically Active Dyes: Adsorption. W. R. Brode, with R. Adams. *J. Amer. Chem. Soc.*, 1926, **48**, 2193-2206.

(1) The paper describes further careful dyeing experiments on wool and silk with the active and racemic modifications of certain dyes, in the hope of determining whether chemical action takes place in the dyeing process. It is found that the active isomerides of optically active dyes have the same physical properties, including adsorption by inert and active materials, absorption, colour, fastness to light, &c. The rotatory dispersion curves of these active dyes and of the intermediates used are found to be normal. No apparent difference in adsorption of the two active forms could be detected in the dyeing experiments. The racemic dyes appear to be adsorbed to a greater extent than the active dyes, by both inactive and active adsorbing agents. A new type of asymmetric dye has been prepared from an asymmetric derivative of benzylamine.

(2) Two asymmetric dyes from *m*-aminomandelic acid have been synthesised and their absorption spectra in various solvents determined. Dyeing experiments with these dyes have failed to confirm previous results obtained by Porter and Ihrig. No rotation was observed in any of the solutions examined and no evidence has been obtained which would indicate the selective adsorption of one of the enantiomorphic forms of the racemic dye. The data afford additional proof that the dyeing mechanism is not necessarily a chemical phenomenon. —B.C.I.R.A.

Colour: Purity. (1) I. G. Priest. (2) D. B. Judd. *J. Optical Soc. America*, 1926, **13**, 123-154.

(1) The author applies his colorimetric purity formula to the computation of the purity of non-spectral colours ("purples").

(2) The author enumerates the purity formulæ in existence and derives a further one. The several formulæ are investigated from the point of view of convenience and accuracy, and the procedure necessary for accurate computation is described. The purity formulæ are extended to non-spectral colours and a general solution is given for the tri-linear co-ordinates of a colour in terms of the purity, the luminosity coefficients and the co-ordinates of the spectrum scale.
—B.C.I.R.A.

Dyeing Scents. E. Hibbert. *J. Soc. Dyers and Col.*, 1926, **42**, 249-254.

A detailed account of the scents or smells characteristic of material dyed with various dyes, mainly natural vegetable dyes, such as the lichens or "crottles" long used in Scotland for dyeing tweeds various shades of brown. —L.I.R.A.

Viscose Silk: "Blinding" in Dyeing. F. M. Rowe. *J. Soc. Dyers and Col.*, 1926, **42**, 207-208.

The production of insoluble azo colours on viscose is limited in that certain combinations may "blind" the fibre, that is, render it non-lustrous. A combination which shows the phenomenon in a marked degree is 1% Naphthol AS-RL and 5% Fast Orange G salt and another combination producing the effect is 1·5% Naphthol AS-BO and 7·5% Fast Orange G salt. When finished with soap and soda at 60° C. these combinations give fine orange shades, but on boiling blinding occurs, the skeins appear dead and non-lustrous and the colours are respectively bluish-red with an orange cast and dull red. Examination under the microscope shows the non-blinded fibres to be evenly stained whilst the blinded fibres consist of a suspension

of aggregates of colouring matter evenly distributed throughout the virtually colourless fibre. (Photomicrographs are reproduced.) The blinded fibres appear to be non-lustrous because the solid particles of colouring matter mask the lustre, but actually the lustre is unimpaired. The soap and soda used in finishing have no connection with blinding; the effect can be produced by boiling water only. Blinding appears to be solely a temperature effect connected with the degree of solubility of the individual colouring matter in viscose. Tendency to cause blinding is a function of the azo colour itself, not of the diazotised base or the naphthol. Some combinations not causing blinding are indicated. —B.C.I.R.A.

Dyes: Adsorption. G. Testoni. *Chem. Abs.*, 1926, **20**, 1931-1932 (from *Ann. chim. applicata*, 1926, **16**, 45-52).
The adsorption of acid and basic dyes by the acidic, basic, and neutral adsorbents silicic acid, aluminium hydroxide, and kaolin was examined to discover if a relation exists between chemical constitution and adsorption. The criterion of adsorption was an intense colouration of the adsorbent and inability on prolonged washing to remove the colour. Silicic acid adsorbed basic colours whatever their constitution or their molecular weight. Some colours which ordinarily behave on dyeing as acidic were likewise adsorbed by silicic acid. Aluminimum hydroxide adsorbed acid dyes, but also in some cases, basic dyes. A large proportion of both types of dyes was adsorbed by kaolin. The adsorption followed Ostwald's adsorption law. Measurements of the adsorption of certain inorganic salts by the same adsorbents showed that these do not follow Ostwald's law; with the most dilute solutions decomposition of the salt occurred; at high concentration only adsorption occurred, but with increasing dilution both adsorption and salt-formation took place. It is possible that with organic dyes there is, besides adsorption, a chemical reaction between the dye and the adsorbent with the formation of a salt. —B.C.I.R.A.

Notes of Re-dyeing. *Dyer and Calico Printer*, 1926, **56**, 71 (from *Nat. Assoc. of Dyers and Cleaners' Review*).
Even re-dyeing of partly sun-faded woollen garments is obtained by pre-oxidising the garment with hydrogen peroxide or potassium permanganate; in the case of re-dyeing in black shades the garment may be treated with a dilute solution of sodium hypochlorite. Sun-faded woollen garments are subject to excessive deterioration when treated with alkaline liquors. —A.J.H.

Multi-colour Effects on Mixed Rayon Materials. Dr. L. L. Lloyd. *Silk J.*, 1925, **2**, No. 14, p. 79.
It is necessary to set the yarn before dyeing to prevent the twist from becoming uneven. Yarns of mixed materials dyed in different colours have many uses; there is little difficulty in their production. Fast-to-light combinations are rather restricted. Mixtures of two or more rayons may be used in different shades. The glare of rayon may be modified to produce pleasing results and the draping qualities improved by treating with acetic or formic acids or with pyridine. —F.G.P.

Increasing the Penetration of Fibres in Dyeing. *Text. Argus*, 1926, **3**, 27th Oct., p. 7.
Penetration of fibres by dyestuffs is dependent on the degree of dispersion of the dye particles in a dye liquor and the porosity of the fibres. Wetting-out agents assist penetration since they promote the wetting-out of the fibre, thereby causing it to swell. The impurities in fibres resist penetration by dyes since they decrease the porosity of the fibres. —A.J.H.

Dyeing of Artificial Silk. E. Greenhalgh. *Dyer and Calico Printer*, 1926, **56**, 146-147.
The concluding article of a series. Cellulose acetate silk is almost always even-dyeing, being much superior in this respect to viscose. The even-dyeing properties of cellulose acetate silk are attributed to the comparatively coarse dispersion of the dyes applied to it. The finishing of cellulose acetate silk fabrics containing cotton or viscose usually consists merely of stentering to width without the use of filling assistants. —A.J.H.

Dyeing of Vat Colours. J. S. Heuthwaite. *Dyer and Calico Printer*, 1926, **56**, 152-153.
A description of the working of the indigo fermentation vat. —A.J.H.

Foreign Vegetable Dyes. A. R. Horwood. *Dyer and Cal. Printer*, 1926, **56**, 174-176.
Interesting historical notes on the use of madder, camwood, brazilwood, barwood, sandalwood, indigo, logwood, fustic, turmeric, quercitron, and cutch. —A.J.H.

Scouring and Dyeing Worsteds. *Dyer and Calico Printer*, 1926, **56**, 180 (from *Text. World*).
Brief notes on practical methods for dyeing scoured wool with acid and mordant dyes. —A.J.H.

Tetracarnit: Properties. R. Roestel. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 315-316.
The high wetting power, dyestuff dissolving, stripping, and dispersing powers of tetracarnit are demonstrated. —B.C.I.R.A.

Sulphur Black Dyeing; The So-called Antioxidation of——. K. Brass. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 316-320).
After reviewing previous work the author describes a series of experiments relating

to the production of sulphuric acid during the storage of goods dyed with Sulphur Black. His results show that after-chroming has a powerful effect in reducing this trouble and that soaping following chroming should be avoided. Instead of soaping, a prolonged treatment with ample supplies of boiling water is recommended. Goods dyed with Sulphur Black should be stored for as short a time as possible.

—L.I.R.A.

Non-corrosive Caustic Soda Discharge Pastes: Preparation. W. Sieber. *Melliand's Textilber.*, 1925, **6**, 829-830.

The author investigated the common method of making starch and British gum caustic soda discharge pastes for use in colour printing; and found that if the caustic soda solution is added gradually to the thickening agent a temperature rise is avoided and a homogeneous, flowing mixture is obtained instead of one which is flocculated or coagulated. Such a preparation does not corrode either the print roller or the doctor. Directions for preparing the discharging agent are given. The cause of the damage to the copper roller is ascribed to the formation on it of a cement-like substance as a result of chemical action between the caustic soda and the thickening agent under the influence of the heat developed in former methods of mixing. If the heat evolution is prevented as in the author's method of mixing this chemical action does not occur to any extent. —B.C.I.R.A.

Vat Dyes: Application. H. Pomeranz. *Melliand's Textilber.*, 1925, **6**, 840.

In connection with Brass's theory the author draws attention to the previous work of his own and Haller's and to some work cited by Erban in which experiments on indigo blue dyeing led to the conclusion that the physical structure of the dye on the fibre differed from that of the dye itself. He is of the opinion that Brass's account of his experiments with Indanthrene Blue is not a certain indication that only the vat acids and not their alkali or alkaline earth salts have an affinity for cotton and he points out that the term vat dye does not indicate the behaviour in dyeing of a class of dyes and that, even if for Indanthrene Blue the sodium salt of the vat acid has no affinity for cotton, this is not sufficient grounds for formulating a law for all vat dyes. —B.C.I.R.A.

Indigo Vat: Effect of Added Substances. R. Haller. *Melliand's Textilber.*, 1926, **7**, 612-615.

A more complete report with an account of the experiments. Emulsoids have an *un*favourable effect (corrected statement) on the vat and on the dyeings obtained from it. Alcohols, ketones, and similar substances have a favourable effect. Wetting agents are unfavourable whilst electrolytes are valueless and may even be injurious. —B.C.I.R.A.

Naphthol AS Series: The Use of the, in Printing and Dyeing. W. Kielbasinski. *Melliand's Textilber.*, 1926, **7**, 694.

A lecture, followed by a discussion, in which a number of practical details concerning the use of the Naphthol AS series of products were brought forward.

—L.I.R.A.

Naphthol AS Dyes: Application. W. Kielbasinski. *Melliand's Textilber.*, 1926, **7**, 611-612.

The author describes the origin of the naphthol colours by condensation of the β-oxynaphthoic acid described by Pokorny in 1891 with aromatic amino bases. The first two naphthol colours put on the market were Naphthol AS, the condensation product with aniline, and Naphthol NA, obtained with meta-nitraniline. After the war a series of condensation products was prepared and it was proposed to couple them with diazotisable bases so that a number of valuable dyes could be produced on the fibre. The composition of seven of the Rapid Fast colours, which are mixtures of nitrosamines and Naphthol AS, is given. The article concludes with a few practical hints on the application of the naphthol colours. —B.C.I.R.A.

Sulphur Dyes: Application. C. Koox. *Melliand's Textilber.*, 1926, **7**, 543-544.

The following method is described for correcting the bronzing of sulphur dyes. After completion of the dyeing process the colour is cleared in a boiling bath containing lactic, formic, or acetic acid and Monopol brilliant oil (with scroopy fabrics this oil is replaced by an oil emulsion). Potato starch which has been cooked for a short time with water is added rapidly to the clearing bath or is simply added with cold water to the bath. The starch is subsequently removed in a bath containing acetic, lactic, or formic acid, diastase and an oil emulsion. Bronzing on artificial silk through dyeing from saturated basic dye baths can be avoided by the addition of potato starch to the dye bath. Bronzing in the tannin dyeing of artificial silk, due to the fixation on the fibre of an insufficient quantity of the tannin-antimony compound can also be prevented by the addition of starch to the dyebath. —B.C.I.R.A.

Indigo Vat: Effect of Added Substances. R. Haller. *Melliand's Textilber.*, 1926, **7**, 541-542.

The following conclusions are drawn from experiments on the effect of adding various substances to the indigo vat on the vat itself and on the resultant dyeings. All additions which change the electrical character of the indigo white particles, that is all emulsoids, have a favourable influence on the vat and on the fastness of the dyeings obtained from it. All additions which increase the degree of dispersion of the indigo white particles give dyeings which are faster than those obtained from

a normal vat. Addition of salts, if the concentration is not too great, appear to have no effect either on the vat or on the resultant dyeing. —B.C.I.R.A.

Dyes: Matching. G. Rudolph. *Melliand's Textilber.*, 1926, **7**, 537-538.

A general article on dyeing to shade. Some examples are discussed of the apparent changes in shade of a grey tone produced by different mixtures of blue, yellow, orange, and red when the shades are examined in different kinds of daylight and artificial light. —B.C.I.R.A.

Dyes: Fastness. F. Weiss. *Melliand's Textilber.*, 1926, **7**, 448-450, 533-534, 618-619.

The relation between the chemical constitution of dyes and their fastness to alkalis, acids, oxidising and reducing agents and light is discussed. In general, it may be said that the reactivity of dyes decreases as the size of the molecule increases. Closed ring systems are more stable than open chains. The fewer the reactive groups contained by the molecule the less it is attacked. Side chains and double bonds afford points of attack and the existence of tautomeric forms in equilibrium increases the reactivity of dyes. —B.C.I.R.A.

Dyeing Properties of Wool exposed to Sunlight. v. Bergen. *Melliand's Textilber.*, 1926, **7**, 451-457.

Wool, on exposure to light, changes its chemical composition and acts quite differently towards dyes. Table 1 shows 34 dyes which have been tested on exposed and unexposed wool. Many produce darker shades (positive effect) whilst others produce lighter shades (negative effect) on exposed wool. The maximum effect, as regards the former is after 300 hours' exposure to direct sunlight. It is of interest that indigo shows a positive behaviour towards wool which has been exposed for 100 hours and the opposite after 200 hours' exposure. The effects of direct sunlight, exposure under glass, and a mercury vapour lamp have been compared, and results show that the wool is affected most rapidly by the mercury vapour lamp and that glass acts as a partial protective agent. As far as the influence of the dyeing method is concerned, indigo dyed from either an alkaline vat or acid solution does not alter its negative effect. Alacerin Cyanin Green E, if dyed from a neutral or acetic acid bath, shows a negative effect, but a positive effect when dyed from a sulphuric acid bath. Also, exposed wool has an acid reaction towards Methyl Orange and Litmus, whereas unexposed wool has an alkaline reaction. B.R.A.W. & W.I.

Viscosity of Dye Solutions. See Section 6.

Dyehouse: Steam Consumption. See Section 7c.

(J)—Printing

Batik Fabrics in Java: Printing. P. Mijer. *Amer. Dyestuff Rep.*, 1926, **15**, 419-421.

A general account of native procedure in the production of batik. Batiks came from Java as early as 1563. —B.C.I.R.A.

Development in Calico Printing. R. Sansone. *Dyer and Cal. Printer*, 1926, **56**, 172-173.

Methods and apparatus for dyeing Para Red. Reference is made to the more recent Naphthol AS colours. —A.J.H.

Imitation Woven Effects. *Chemicals* (N.Y.), 1926, **26**, No. 11, p. 21.

The fabric is printed with a viscous substance that has the property of coagulating in a liquid. The substances are cellulose or its derivatives in suitable solvents, especially a solution of cellulose acetate in acetic acid which coagulates in water. For the production of relief effects imitating embroidery the precipitation must take place at the moment of contact of the cloth with the printing roller. Water is supplied from a wool wrapped roller taking moisture from a trough. Good results are obtained from a solution of 14 parts acetate in 86 parts of acetic acid (7° Bé.). White and coloured pigments that resist acetic acid may be added. The paste may be printed on dyed or printed fabrics, they are fast to water, soap, and some rubbing. Cellulose in cuprammonium hydrate may be used. —F.G.P.

Printogens: Application. G. Tagliani. *Melliand' sTextilber.*, 1925, **6**, 922-923.

Printing difficulties caused by acid, alkaline, or fat-containing printing colours are discussed and the Printogens (apparently highly viscous hydrocarbons) are indicated as suitable means for overcoming these difficulties. Addition of the Printogens to strongly acid, strongly alkaline, or foaming printing colours prevents corrosion of the roller and doctor, coating of the roller and insufficient printing of the colour, and gives clearer, sharper pattern outlines. Printing colours containing the Printogens are more homogeneous and show no tendency to foam. Viscous paste-like thickenings become more yielding in the presence of the Printogens which also protect thickenings from moulding and from too rapid evaporation and change of consistency. —B.C.I.R.A

Reserve Effects; The Production of, by the Use of the Sea-weed Extracts "Norgin" and "Algin." —. Kunig. *Melliand's Textilber.*, 1926, **7**, 538-539.

An 8-10% solution of Norgin is printed on to the fabric and dried. "Coagulation" is then secured by treatment with a solution of the salt of an alkaline earth or of a heavy metal. The coagulated Norgin has the property of resisting the penetration of dyestuffs to a marked degree. It is essential to ensure that a sufficient quantity

of Norgin is applied to the fabric. If desired, a chemical reserve may be incorporated with the thickening; a lighter application is then satisfactory. The Norgin reserve may be used with all dyes that require no free alkali in the dyebath and which will withstand weak acid and alkaline baths. Dye-vats in which lime is used as alkali may however be used if the temperature is kept low. The coagulated and dried Norgin film may be caused to crack in well-defined fissures, a property which permits finely-veined batik effects to be obtained. After dyeing the Norgin reserve is discharged by a weakly alkaline bath. —L.I.R.A.

Calico Printing. —. Reinking. *Melliand's Textilber.*, 1926, **7**, 539-541.

The "Traité sur les Toiles Peintes" written in 1760 by the Chevalier de Quarelles is not, as stated by the Badische Anilin-und-Soda Fabrik, the oldest text book dealing with calico printing. A book, written about 1400 by the painter Cennino Cennini, of which the original is lost but of which there are various copies, contains a chapter on the calico printing methods of his time. Already, in 1400, and probably some 200 years earlier, cut wooden blocks were used. The contours were printed on undyed and previously dyed cloth with oil colours and afterwards brush painted. Pigments were used and were fixed with varnish. The art of printing was widely spread but printed materials of the 14th century are extremely rare. Pieces of printed hemp canvas discovered at Sion in the Rhone Valley and now in museums in Basle and Zurich are described. The fabric dates from the 15th century and was produced in Italy, probably in Venice. In the Zurich piece the unprinted parts are partially disintegrated. —B.C.I.R.A.

Potassium Compounds: Application. W. Sieber. *Melliand's Textilber.*, 1926, **7**, 615-616.

Attention is drawn to some uses of potassium compounds in calico printing. Purer whites are obtained when potassium citrate is used to reserve or discharge aniline black than when either citric acid or sodium citrate is used. The browning in air of fabric impregnated with sodium hydroxide-β-naphthol solution for the production of azo dyes is entirely eliminated by preparing the naphthol solution with potassium hydroxide, and in coupling the naphthol with diazo solutions the known instability of acetic acid diazo baths is avoided by preparing a solution of the amino and a mixture of ice and hydrochloric acid (19° Bé.), mixing the two and adding solid sodium nitrite at —5° C. Such baths are said to remain stable for a long time and the absence of sodium acetate cheapens the process. Reference is also made to the use of potassium hydroxide in vat dyeing. —B.C.I.R.A.

Indigosols: Use in Printing. See Section 4I.

Use of Naphthol AS Series in Printing. See Section 4I.

(K)—Finishing

Artificial Silk and Union Fabrics: Finishing. W. Bennett. *Silk J.*, 1926, **3**, No. 26, 66-67.

General notes on conditioning, lustring, and stiffening. —B.C.I.R.A.

Appret-Avirol E: Application. Chemische Fabrik H. Th. Böhme A.-G. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 241.

To prepare a finish, Epsom salts and dextrin are dissolved hot, cooled, and Avirol E stirred in. A hot calendering process employing high pressure is used. The Epsom salt fills and loads the fabric without stiffening it. —B.C.I.R.A.

Lysamil: Application. Diamalt A.-G. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 241.

Lysamil is a substance for improving the fastness to rubbing of different dyestuff groups. Pattern cards are available showing the way in which the product acts with cotton. Lysamil is applied in the after-treatment bath and does not involve a separate process. —B.C.I.R.A.

Leather; Artificial, the Production of——. G. Durst. *Melliand's Textilber.*, 1926, **7**, 531-533.

The author gives recipes for mixtures that may be applied to cloth for the production of artificial leather. The methods of application and finishing are briefly described. The mixtures used consist of celluloid, castor oil, and mineral colouring matter. —L.I.R.A.

Textile Fabrics: Steaming. K. Wagner. *Melliand's Textilber.*, 1926, **7**, 535-536.

The change induced in textile materials by steaming, the controlling factors in the process, the purposes of wet and dry steaming and the condition of the steam employed are discussed. —B.C.I.R.A.

Avirol E: A Modern Finishing Oil. M. Nopitsch. *Melliand's Textilber.*, 1926, **7**, 688-689.

The advantages of Avirol E as a softening agent are put forward. This oil has the property of giving clear solutions even in the presence of large quantities of magnesium sulphate. Sample cuttings of cloths finished with mixtures of dextrin, magnesium sulphate, and Avirol E are given. —L.I.R.A.

Lace Finishing. See Section 4G.

Patents

Beet Molasses: Application. M. Bergmann, —. Immendörfer, and —. Loewe. D.R.P.417,707 (from *Melliand's Textilber.*, 1926, **7**, 562).

Damage to the fibre in finishing processes in which textile materials are treated with

alkalis, acids, oxidising or reducing agents can be considerably reduced if beet molasses or its essential constituent, betaine, is employed in the process. The method has proved effective in the washing of raw wool with soda and in bleaching cotton with peroxides. —B.C.I.R.A.

Increasing Water Resistance of Artificial Silk. H. Karplus. U.S.P.1,591,922 (from *Chemicals* (N.Y.), 1926, **26**, No. 11, p. 26).

Rayon fabric is soaked for several hours in 30% formaldehyde containing 1/10% sodium hydrate; after whizzing, the material is heated to 140-150° C. for 1-5 hours, and then washed and finished. Another method is to use 40% formaldehyde with 1-2% calcium lactate or 0·1-0·8% sodium formate or 0·1-1·0% sodium oxalate. The function of the additional substances is to protect the rayon during the heating. —F.G.P.

Cellulose Acetate Silk: Dyeing. British Celanese, Ltd., London, and G. H. Ellis, Spondon, near Derby. E.P.253,978.

For dyeing, printing, and stencilling yarns, fabrics, films, &c., made with or containing cellulose acetate, the colouring matters of the stilbene group which contain no sulpho groups are employed. The dyestuffs may be applied as such or they may be formed within the fibre by coupling the diazotised amino-stilbene with suitable developers. Examples are given of suitable developers and the shades produced by them. The dyestuffs may be employed in the finely ground or dispersed condition; the process may be applied to mixed goods containing cellulose acetate and resist, differential or solid effects may be obtained, appropriate dyes being used, if desired, for the non-acetate portion, either separately or simultaneously. Examples are given. —B.C.I.R.A.

Halogenated Naphthalenes, and Moth Proofing of Textile Fabrics. Graesser-Monsanto Chemical Works, Ltd., Ruabon, Denbighshire, and A. M. Cohen, London (for the late H. M. Lefroy). E.P.253,993.

Textile fabrics, wood, furs, leather, &c., are impregnated with a poly-halogenated naphthalene. According to examples—(1) A textile yarn or fabric is impregnated with or has sprayed on to it a 5% solution of trichlor- and/or hexachlornaphthalene in benzole, whereby it is rendered moth-proof. The solution is sufficiently dilute to prevent modification of the physical properties of the fabric. (2) A fabric is immersed in an emulsion obtained by diluting a mixture containing 25 parts of monochlornaphthalene, 25 parts of trichlornaphthalene, 47 parts of water and 3 parts of ammonium oleate. (3) A fabric is treated with a solution in one gallon of water of 2 ounces of a soap containing 10% dichlornaphthalene. Two examples for the treatment of timber are given. The higher brominated naphthalenes may replace the poly-chlorinated naphthalenes or mixed bromo-chloronaphthalenes may be used. According to the first Provisional Specification, the treatment may include the use of gases and vapours, providing the material is finally impregnated with a chlorinated hydrocarbon of low vapour tension, and in the case of fabrics, the impregnation may be performed during the ordinary finishing process, or during the process of dry cleaning. —B.C.I.R.A.

Dyeing Cellulose Esters. British Alizarine Co. Ltd. and C. M. Barnard. E.P. 252,646. *Oil and Colour Trades J.*, 1926, **70**, 1312.

Cellulose esters are dyed with compounds of the type formula A.X.Y.COOH, where A is a non-sulphonated aryl dye-nucleus, X an atom of oxygen or sulphur, and Y is a straight or branched aliphatic chain. The dye-nucleus may be anthraquinone or an azo compound. Amongst those specified are—(1) An azo dye made by condensing *p*-nitrophenol with chloracetic acid, reducing the nitro group, diazotising and coupling with β-naphthol. (2) 1- or 2-anthraquinonethioglycollic acid. (3) 1-aminoanthraquinone-2-thioglycollic acid (made by condensing 1-amino-2-mercapto-anthraquinone with chloracetic acid in the presence of alkali and glucose). (4) The products made by boiling 1-amino-2 : 4-dibromanthraquinone with sodium sulphide and condensing with chloracetic acid. —F.G.P.

Hosiery Dyeing Machine. C. H. Hartig, Drammen, Norway. E.P.254,254.

An apparatus for dyeing materials, particularly stockings, comprises an oval tank having a central wall arranged to form a circulation channel, and members for advancing the materials. Perforated side walls and false bottom are provided and the bath may be steam heated. —B C.I.R.A.

Cellulose Ester Fabrics: Embossing. C. Dreyfus, London. E.P.254,354.

An ornamented or patterned fabric is produced by subjecting a woven, knitted, or other fabric composed of or containing filaments or fibres of a low flammable thermoplastic cellulose derivative to the local application of pressure under suitable conditions of temperature. The process may be facilitated by the use of plasticising or softening agents or solvents for the cellulose derivative applied before or after weaving. —B.C.I.R.A.

Fabric Printing Machine. A. Crompton, Openshaw, Manchester. E.P.254,441.

Textile fabrics are printed by passing them between an uninked printing roller formed with the design in relief, and a co-operating pressure roller to which colour is conveyed by a band travelling over a roller in engagement with a second roller partly immersed in a colour trough. —B.C.I.R.A.

Dye Spraying Machine. F. Hubl, Vienna. E.P.254,508.

In apparatus for printing designs by spraying colour through stencils the spraying nozzle is moved mechanically to and fro over the width of the article to be decorated in tracks which are independent of the stencil openings, the nozzle being opened at the desired places by members arranged according to the stencil openings. In the form shown the fabric is fed forward intermittently over a table by means of an endless band, a stencil being lowered on to the fabric in the positions of rest. The spraying devices are arranged on a common carriage initially at the left-hand side of a member which is reciprocated on guides across the width of the fabric, the carriage being moved to the right one division at the end of each stroke by means of springs, whereby the nozzles are given a zigzag movement. A plate is provided with a set of regulating cards acting on levers so as to open the nozzles as required. —B.C.I.R.A.

Mercerising Range Stretching Mechanism. Sir J. F. Norton & Co. Ltd., Salford, Lancashire. E.P.254,685 and 254,686.

(1) In chainless mercerising machines in addition to the breadth stretching apparatus means for stretching the fabric longitudinally is employed, the said means being arranged between the steeping apparatus and the breadth stretching apparatus and comprising three rollers, one situated above the levels of the other two. The top roller is capable of being adjusted for varying the tension of the fabric by means of a screw operated by worm gearing from a band wheel. In a modification the tension is maintained by means of weights acting on one of the rollers.

(2) Chainless mercerising machines for fabric in the open width are arranged with stretching, washing, and rinsing apparatus, so that the stretching devices are subdivided in the running direction of the fabric by being placed at different levels, those at the lower level being located in a treatment tank provided with devices for spraying both sides of the fabric.
—B.C.I.R.A.

Hot Concentrated Alkali Fibre-strengthening Solutions. O. Dubac, Heidelberg, Germany. E.P.254,695.

New and more durable effects are produced on vegetable fibres, especially cotton, raising their strength and elasticity, increasing their crinkliness and reducing their tendency to shrink, by treating with strong caustic soda of from 50-125° Bé. at a temperature of 60-100° C. or higher. The effects vary with the nature of the vegetable fibres treated and when applied to the fibres in fabric form the product obtained may resemble wool, silk, or linen, according to the nature of the weave.
—B.C.I.R.A.

Washing Machine. C. Früh, Zurich, Switzerland. E.P.254,706.

For washing or dyeing textile goods or fabrics, the goods, &c., are transported from one porous endless conveyer band to other endless bands situated below, being meanwhile sprayed from tubes. The bands are driven from a motor at different speeds, the lowermost slowest and the middle band in the reverse direction. A greater number of sprays, and sprays with larger holes are used in that part of the machine first traversed by the goods. The first spray of a lower set is arranged to squirt off any goods that may adhere to the upper band. Trays catch the liquid which passes through the upper bands and it is conducted down to a side tank. Liquid passing through the lowest band collects in a tank.
—B.C.I.R.A.

Fabric Impregnating Device: Description. E. Weinheim, New York. E.P.255,094.

Fabrics, paper, fibre, &c., are impregnated or coated by applying the coating, &c., material to a run of fabric, &c., which is maintained under uniform tension before, during, and after the material is applied. The fabric is led from a drum driven by rollers, and passed through pressure rollers, the coating material flowing from a container on to the fabric before it reaches the pressure rollers. —B.C.I.R.A.

Calender Roller Surface Combustion Burner. F. J. Cox, Camden Town, London, T. G. Tulloch, and G. E. Millner, Westminster. E.P.255,215.

Calendering rollers, &c., are heated by surface combustion burners. The roller is heated by a cylindrical fireclay burner formed by sections mounted on a perforated gas-pipe which communicates with a mixing chamber having gas and air inlets.
—B.C.I.R.A.

Surface Combustion Singeing Machine. F. J. Cox, Camden Town, London, H. Edmunds, T. G. Tulloch, and G. E. Millner, Westminster.

Yarns, &c., are dried and singed by passing them over surface combustion burners. The material is passed over the incandescent surfaces of rows of surface combustion burners, each burner consisting of a gas chamber having a cover of fireclay, &c. Jets of air are directed by a pipe on to the material so as to prevent injury to it. The speed of travel of the material and its distance from the heating surfaces may be varied. In a modification, the material is passed between two superposed rows of burners, the heating surfaces of which are opposite to each other. —B.C.I.R.A.

Lace Thread-clipping Machine. G. Cordier, Calais, France. E.P.255,248.

A machine for cutting the loose threads of machine-made lace or other fabrics prior to shearing, comprises a number of clipping tools which are reciprocated across the

fabric in a transverse direction to the length of the fabric as manufactured, and in a direction parallel to, or making an angle up to 45° with, the direction of motion of the goods in the machine. The tools are arranged to engage several times the part of the fabric where any particular loose thread is situated. —B.C.I.R.A.

Yarn Mercerising Machine. T. McConnell, Easthampton, Mass. E.P.255,257.

Yarn is fed to a mercerising or other bath through rollers and over a guide. After passing under tension under a roller in the bath it passes between two stretching members which are positively rotated, and comprise spiders with rollers connecting the free ends of corresponding arms. The yarn is then again immersed under tension in the bath and passed between similar stretching members and delivered by rollers. If desired the yarn may be passed through the whole bath again, guides being provided for returning the yarn to the feeding end of the machine. —B.C.I.R.A.

Dyeing Machine. G. W. Johnson, London (for Hussong Dyeing Machine Co., New Jersey, U.S.A.). E.P.255,270.

In dyeing machines of the kind described in Specification 237,428, the cage is provided with a perforated bottom capable of being opened and closed for discharging purposes. The cage is attached to the beam structure by straps which pass through holes in the beams and are secured by wedges. The top is permanently secured to the beams by bolts surrounded by tubes. The bottom is composed of hinged sections braced to support the load. A hinged sample door is provided in the top of the cage. —B.C.I.R.A.

Drying Machine Fabric Festooning Mechanism. A. Lambrette, Membach-Dolhain, Belgium. E.P.255,297.

In apparatus for drying or chemically treating long lengths of fabric, &c., the fabric is formed into festoons as it enters the treatment chamber by the engagement of toothed sectors on the supporting arms of the rails with fixed stops, the arms being pivoted to travelling endless chains arranged at the opposite sides of the chamber. The formation of the festoons and the transverse spreading of the fabric are assisted by jets of compressed air. Each of the rails may be formed with a ridge or provided with a blade for facilitating the formation of the festoons. In a modification the rails are directly attached to the endless chains which are driven forward intermittently a distance equal to the spacing of the rails. In this case one of the air jets is dispensed with. The jets may be provided with a throttle valve which is actuated by the moving rails. —B.C.I.R.A.

Phosphorus Chlorides. Heberlein & Co., A.-G., St. Gallen, Switzerland. E.P. 255,453.

The chemical properties of vegetable fibres, particularly their dyeing properties, are varied by treatment with a halogen compound of phosphorus in the presence of an alkali. Cotton so treated loses its affinity for substantive dyestuffs, while it acquires a pronounced affinity for basic dyestuffs, without previous mordanting. In examples, cotton yarn is treated with alcoholic caustic soda solution, and then, after expressing excess solution, with a solution of phosphorus trichloride in xylene; a cotton fabric is converted into soda cellulose in the usual manner, and is then treated with a solution of phosphorus oxychloride in benzene. Halogen compounds of phosphorus containing an organic substituent may be used instead of the inorganic phosphorus chlorides. —B.C.I.R.A.

Intermittent Printing Machine. Calico Printers' Association, Ltd., F. Farnworth and I. H. Gilbertson, Manchester. E.P. 255,626.

In a machine for printing intermittent patterns on fabrics, the printing rollers are moved to and from the impression cylinder by cams on a shaft which is driven from the shaft of a blank roller of similar dimensions to the printing rollers, the blank roller rotating constantly in contact with the impression roller. The printing rollers and the blank roller are driven by box wheels from a crown wheel loose on the shaft of the impression roller. The shaft of the printing roller may drive the cam-carrying shaft by means of sprocket gearing fitted with a spring-pressed tensioning roller, but preferably this shaft is driven from the shaft of the blank roller by means of change-gear wheels. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Carbonising—

255,725. W. M. R. Jahr. Apparatus for acidising fabrics for carbonising purposes.

Dyeing—

254,649. J. M. Vogel and C. S. Plant. Colour chart.

255,003. A. L. Mond. Preparing yarn bobbins for dyeing, washing &c.

255,501. Durand & Huguenin Akt.-Ges. Dyeing of animal fibres.

Finishing—

254,609. E. Ricaleus. Fulling and felting process.

5—LAUNDERING AND DRY CLEANING

Laundry Machines and Looms: Designing. L. A. Legros and H. C. Weston. *Reports of the Ind. Fatigue Res. Bd.*, 1926, No. 36, 33 pp.

The paper is a report of a general survey of repetitive machines with the object of

disclosing defects in design which lead to undue fatigue or injury to the operator. Improvements have been suggested in the feed and delivery of goods to Decoudun flat ironer and similar machines, in the pedal movement in shirt and collar ironing machines and in the pedal arrangement of cuff ironing machines. A shock-absorbing device has been suggested for garment presses. The noise of looms and the warp breakages due to heald cords being affected by atmospheric changes are touched upon.
—B.C.I.R.A.

Burnus: Detergent Properties. P. Heermann. *Chem. Abs.*, 1926, **20**, 1332 (from *Seifensieder Ztg.*, 1926, **53**, 59-60, 80).

Burnus is a cleansing preparation containing the tryptic enzyme of the pancreas and its effectiveness is due to the digestion of albuminous matter during the pre-soaking period of dirty wash. The fibre is not attacked. —B.C.I.R.A.

Artificial Silk Fabrics: Laundering. *Silk J.*, 1926, **3**, No. 25, p. 66; also *Amer. Dyestuff Rep.*, 1926, **15**, 397.

An investigation was made by American artificial silk manufacturers co-operating with the Pilgrim Laundry and the Cotton Research Company into the laundering of artificial silk goods. The results of the investigation are summarised and a satisfactory washroom procedure is prescribed.
—B.C.I.R.A.

Colloidal Clays as Soap Fillers. R. D. Eshbaugh. *Chem. Abs.*, 1926, **20**, 2423 (from *Soap*, 1926, **1**, No. 9, p. 13).

Besides detergent and lathering properties, other advantages claimed for colloidal clay or bentonite are—(1) Soap dissolves more quickly. (2) Soap is less likely to contain free alkali or free fatty acids. (3) It improves on ageing. Soap containing colloidal clay lowers the surface tension 9·1% and 6·9% more than the pure soap at 20° and 45° C. respectively. It is said that some bentonites can replace 25-50% of the soap substances producing a soap equal or superior to ordinary soap.
—B.L.R.A.

Gall; Detergent Properties of——. —. Hercay. *Chem. Abs.*, 1926, **20**, 1908 (from T.I.B.A., 1926, **4**, 331-335).

Review of the comparison and preservation of animal gall and of its use for removing stains, with a number of formulæ of stain-removing preparations containing gall.
—L.I.R.A.

Soap Solutions: Viscosity. B. L. Clarke. *Sci. Abstr.*, 1926, **29**, 461 (from *Medd. K. Vetenskapsakad. Nobelinst.*, 1925, **6**, No. 1, pp. 1-9).

At ordinary temperatures the viscosity of soap solutions of low concentrations increases with age up to a maximum which is reached after about two days and is followed by a gradual decrease which, in the limit, appears to be the same as would be obtained if the solution could be cooled instantaneously from the boiling point to the temperature of the experiment and a reading taken. On boiling the solution the influence of ageing is eliminated, and at 100° C. no change of viscosity with age can be detected. Solutions can in this way be brought to give reproducible viscosity values. With higher concentrations no change of viscosity with age is obtained. The viscosity of aqueous solutions of sodium stearate and sodium oleate are measured at several temperatures over wide ranges of concentration and determinations by Farrow on sodium palmitate are referred to. —B.C.I.R.A.

Patents

Pyrophosphoric Acid: Application. C. A. Agthe, Haselweg, Zurich, Switzerland. E.P.253,554.

Pyrophosphoric acid or its soluble salts are employed as washing or emulsifying agents. A neutral or acid washing agent can conveniently be obtained by adding an acid to normal sodium pyrophosphate. Pyrophosphoric acid or its salts may be used in conjunction with known washing or emulsifying agents such as sulphite cellulose liquor, tragacanth, glue, gelatin, albuminous material or saponin, and also salts of the fatty acids and other soaps.
—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Laundering—

254,581. British - American Laundry Machinery Co. Linen drying apparatus.

254,937. British - American Laundry Machinery Co. Apparatus for starching clothes.

254,950. A. P. Badeaux. Device for drying and cleaning garments.

254,985. British - American Laundry Machinery Co. Fabric drying apparatus.

255,109. F. Aesch-Bach and Artofex Engineering Works, Ltd. Washing machines with closed or enclosed rotary receptacles.

255,563. British - American Laundry Machinery Co. Drying and deodorising apparatus for clothing, &c.

255,929. British - American Laundry Machinery Co. Drying and deodorising apparatus for fabrics.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Densitometer; A New Reflection——. H. M. Cartwright and C. D. Hallam. *J. Sci. Instr.*, 1926, **3**, 246-248.

A simple self-contained instrument is described for measuring the densities of photographic or half-tone prints. The tone under examination is illuminated by the same source as the comparison surface, the angle

of illumination being capable of adjustment. The two surfaces to be compared are placed behind small apertures separated by a black space and the light reflected from them passes through a split convergent lens, which produces an image of the surfaces, one on each of the adjacent faces of a rhomb. By this means the two images are brought into juxtaposition and can be viewed through an eyepiece. Behind the two halves of the lens is placed a screen fitted with two triangular apertures, exposing part of each half of the lens. The area of the aperture can be varied and observed by means of a micrometer screw which controls a sliding leaf. In making measurements with the instrument the comparison surface is used to form both images. With one aperture set at a known position, the other is adjusted to give photometric balance. One of the comparison surfaces is now replaced by the paper whose tone is to be determined and the aperture again adjusted and its proper position read. The ratio of the light reflected from the tone to that reflected from the comparison surface is equal to the area of the aperture in the first case divided by that when the tone was used.
—L.I.R.A.

Mercerisation. W. Gordon. *Kolloid-Z.*, 1926, **39**, 107-110.

An expression is derived mathematically for the contraction occurring in mercerisation. The theory is based on the hypothesis that the cotton hairs in the lye are cylinders of varying cross sections and having forces applied to their ends. The cylinder is regarded as being composed of an amorphous ground substance in which a large number of liquid crystallites (droplets) are distributed symmetrically with respect to a plane normal to the cylinder axis. To the material of the droplets are ascribed the ordinary properties of an incompressible liquid. The droplets are regarded as determining the behaviour of the cylinder. —B.C.I.R.A.

Alkali Blue Tannin Sols: Coagulation by Electrolytes. H. Freundlich and S. Mitsukura. *Kolloid-Z.*, 1926, **39**, 123-127.

The coagulation by different electrolytes of alkali blue sols to which solutions of tannin of increasing concentration are added was followed. With uni-valent inorganic cations, tannin acts as a sensitiser in all concentrations; with di-valent cations tannin acts as a sensitiser only in low and medium concentrations; at higher concentrations it is protective; with tri-valent cations the protective action is mainly predominant, regardless of concentration. No appreciable change in the cataphoretic rate of migration of alkali blue is obtained by the addition of tannin; the sensitising action therefore does not depend on a neutralisation of charge on the colloidal particles but rather on a dehydrating effect of the tannin. The increase of protective action with rising cation valency is compared with the increase in protective action of other hydrophile colloids, e.g., that of gum arabic on silver sols, with increasing valency of the cations. Apparently, protective action is due to the fact that the higher valent ions present in lower concentrations are more readily displaced by the tannin.
—B.C.I.R.A.

Foams; Production of——. O. Bartsch. *Kolloid Z.*, 1926, **38**, 177-179.

Curves are given illustrating the relation between lathering properties and surface tension for a number of homologous fatty alcohols and acids in dilute and concentrated solutions. It is stated quite generally that the fundamental condition for the formation of lather is to be found in the existence of a difference in concentration of the dissolved substance in the boundary surface film and in the bulk of the solution. —B.C.I.R.A.

Wetting Agents; Comparative Experiments with——. P. Krais and H. Gensel. *Leipziger Monats. Text. Ind.*, 1926, **41**, 237-238.

A number of wetting agents at present on the market were compared by noting the time taken for a short length of thread to sink in ½-2% solutions. The surface tensions of the solutions were also compared by Traube's drop-number method. Of the preparations examined, Nekal A (Badische Anilin-u. Sodafabrik, Ludwigshafen a Rh.) and Neomerpin (Chemische Fabrik Pott & Co., Dresden, N.6) showed greatest wetting power. A relatively short sinking-time was obtained only with solutions of at least 1% strength. Below this strength the sinking-time increased rapidly. In nearly all cases a 2% solution gave a shorter sinking-time than a 1% solution. The preparations which gave the shortest sinking times also caused the greatest increase in the drop-number (lowering of surface tension). —L.I.R.A.

Pores in the Crystal Lattice. J. Koenigsberger. *Science Abs.*, A., 1926, 1517 (from *Phys. Z.*, 1926, **27**, 215-217).

Discusses the question of the existence of submicroscopic pores in crystals, the presence of which is indicated by accurate determinations of density and which have been used by A. Smekal to explain the method of electrolytic conduction in many crystals. Describes the changes of form in crystals due to traces of impurities, including cases where the impurity gives colour to the crystal; in many cases there is pleochroism which indicates that the impurity is arranged regularly in the lattice of the crystal. Other facts are considered, and the author concludes that the additional conductivity due to any kind of disturbances (crystal pores) and impurities

in mono-crystals must depend in a marked degree on direction in cases where the symmetry of the space lattice indicates a difference between different directions. —L.I.R.A.

Detection of Mercerised Cotton. C. E. Mullin. *Text. Colorist*, 1926, **48**, 599-601.

A summary of old and new methods for detecting mercerised cotton. —A.J.H.

Phenolic Antiseptics: Effect of *p*H. T. Kuroda. *Biochem. Z.*, 1926, **169**, 281-291.

The antiseptic action of the following substances at different hydrogen-ion concentrations was investigated—phenol, the three isomeric cresols, the three chlorophenols, thymol, benzoic and salicylic acids. *B. prodigiosus*, *B. coli*, and yeast were used for the tests, and the desired *p*H values were obtained with buffer solutions. The action of the phenols and of the aromatic acids was strongest in acid reaction and weakest round the neutral point. Antiseptic action was detectable in strongly alkaline reaction. The distribution coefficient of phenol between olive oil and water is greater in acid than in neutral solution. —B.C.I.R.A.

Aluminium Hydroxides: Constitution. H. Kraut. *Chem. Zentr.*, 1926, **i.**, 3521 (from *Zentr. f. Min. u. Geol.*, A., 1926, 64-80).

The author reviews previous work on the chemistry of the aluminium hydro-gels. The various members of the series identified and their compositions and properties are conveniently tabulated. —B.C.I.R.A.

Salicylic Acid and Benzoic Acid: Antiseptic Action. M. Bornand. *Chem. Abs.*, 1926, **20**, 931 (from *Tech. Ind. Schweiz. Chem.-Ztg.*, 1925, 239-241).

In beef extract a concentration of 0·05% of benzoic or salicylic acid prevents the development of *B. coli* or *B. subtilis*, but 0·15% is required to inhibit that of *Saccharomyces cerevisiæ*. The development of moulds in beer wort is stopped only by 0·25% of either acid. Paper impregnated with either, used for covering preserves, was found to be without action. —B.C.I.R.A.

Diastase: Activity Determination. —. Seeligmann. *Chem. Abs.*, 1926, **20**, 644 (from *Chem.-Ztg.*, 1925, **49**, 943).

A substance has a diastatic power of 1,000 Pollak units if 1 g. is able in half an hour to produce at a temperature of 40° 1 g. of maltose from a 3% arrowroot starch solution. Details for carrying out the determination are given. The maltose formed is titrated with Fehling's solution which has been standardised against pure maltose. —B.C.I.R.A.

Methylene Blue: Properties. W. M. Clark, B. Cohen, and H. D. Gibbs. *Chem. Abs.*, 1925, **19**, 2770 (from *Public Health Repts.*, 1925, **40**, 1131-1201.)

Methylene Blue is of very varying composition and difficult to purify. The numerous samples which were studied show active impurities in the titration with benzo-quinone, the same applying to Lauth's violet. Methylene White solutions are sensitive to light; its rate of oxidation by air varies as the fifth root of the hydrogen-ion concentration. A new set of buffer solutions using citrates is described, and oxidation-reduction potentials are measured at different *p*H. Methylene Blue must be regarded as a very strong base, whilst Lauth's violet has a basic dissociation constant of $1{\cdot}9\times10^{-3}$. The reductant in each case fixes 1 H-ion, and two amino groups have basic dissociation constants as follows—Methylene White, $K_1=1{\cdot}4\times10^{-8}$, $K_2=6{\cdot}3\times10^{-10}$, leuco Lauth's violet $K_1=3{\cdot}8\times10^{-9}$, $K_2=4{\cdot}5\times10^{-10}$. The characteristic potentials at *p*H=0 and 30° are 0·532v for Methylene Blue and 0·563v for Lauth's violet. The corresponding free energies of hydrogenation are calculated and an equation is developed for the relation with the *p*H. Bernthsen's constitutional formula and Wieland's theory of hydrogen transport are discussed. The Schardinger reaction on milk and the test for putrescibility of sewage are controlled electrometrically and various other applications of Methylene Blue are discussed. Methylene Blue does not behave as a reliable reduction indicator. An extensive bibliography is provided. —B.C.I.R.A.

Amylase: Estimation. W. C. Davison. *Chem. Abs.*, 1926, **20**, 61 (from *Bull. Johns Hopkins Hosp.*, 1925, **37**, 281-282.)

The activity of amylase in various substances may be estimated by measuring changes in the viscosity of starch solution. A Lintner starch solution 2·5 times as viscous as water is most suitable. This is added to 100 c.c. of distilled water, boiled 1 minute and then autoclaved at 18 lb. pressure for 15 minutes and filtered through muslin. The reaction is usually *p*H 5·6. This solution should be used within 24 hours after preparation. Ten c.c. of this solution is placed in each of two Ostwald viscometers immersed in a glass water bath at 34° and the time for 5 c.c. to pass through the capillary tube is determined. To one of the viscometers 0·1-0·4 c.c. of amylase preparation is added and to the other an equal amount of the same preparation after it is boiled to act as control. The viscosity of these is determined at intervals of 3 or more minutes for a period of 1-2 hours and the results are plotted. —B.C.I.R.A.

Dyes: Effect of Electrolytes on Adsorption. R. Dubrisay. *Compt. rend.*, 1926, **182**, 1463-1465.

Experiments to test the effect on adsorption of the addition of electrolytes were made with solid adsorbents, including cotton, kieselguhr, asbestos, and silica sand. The adsorbed material consisted of dyes in solution such as Methylene Blue, Congo Red, &c. The quantity of dye absorbed was measured colorimetrically by comparing the colour intensities of the solution before and after contact with the adsorbent. The addition of sodium chloride was again found to increase the amount of adsorption. A simple filter paper strip method of demonstrating the increase in adsorption is described. —B.C.I.R.A.

Causes of Yellowing of Bleached Cotton. J. M. Mathews. *Dyer and Cal. Printer*, 1926, **56**, 114-115 (from *Textile World*).

No satisfactory explanation of the after-yellowing of bleached cotton goods has yet been given. Yellowing occurs in insufficiently bleached cotton, presumably because of reactive impurities not removed, and also in overbleached cotton due to the presence of oxycellulose. Acidic and alkaline conditions favour yellowing, particularly at high temperatures of drying, calendering or storage. Metallic impurities, e.g., iron stains, promote yellowing. —A.J.H.

High Temperature Viscosimeter. H. N. Mercer. *J. Soc. Chem. Ind.*, 1926, **45**, 203-205T.

A new form of viscosimeter for determining the viscosity of oils, melted waxes, &c., is described. Essentially, it consists in a bent tube one arm of which terminates in a capillary. A known weight of the liquid to be tested is introduced into the bend of the tube. After immersion in a bath at the required temperature the liquid is allowed to emerge from the capillary during a given time interval. The volume is obtained from the weight of residual liquid in the tube and the density of the liquid. The method of calibration is shown. —B.C.I.R.A.

Hydrogen Ion Concentration and its Application to Textile Industries. E. R. Trotman. *J. Soc. Dyers and Col.*, 1926, **42**, 208-210.

The meaning of hydrogen ion concentration is briefly discussed and two methods are given for its estimation, namely, the electrical method and the use of various indicators which change colour at different *p*H. The value of the determination of *p*H in the textile industry is discussed, the most important application being the determination of the nature of an acid or an alkali in a textile fabric. —L.I.R.A.

Frictional Electricity. H. F. Vieweg. *J. Phys. Chem.*, 1926, **30**, 865-889.

A frictional electric series has been established, including several substances not previously placed, and showing the effect of using different crystal faces. An explanation of frictional electricity is proposed using the electronic structure of matter as a basis. A suggestion as to the physical significance of Coehn's rule is made. The effect of moisture films on frictional electricity is skown to be related to Lenard's "Wasserfallelektrizität." The charges produced when air is bubbled through various solutions have been measured. These two effects are explained on the basis of the selective adsorption of ions by a gas. —B.C.I.R.A.

Oxidation Before and After the Mercerisation of the Cotton Fibre; Comparison of the Effects of——. E. Knecht and E. F. Muller. *J. Soc. Dyers and Col.*, 1926, **42**, 46-52.

Experiments are described which show that mercerised cotton is more susceptible to oxidation than unmercerised cotton. Mercerisation of oxidised yarn produces tendering and a decrease in the copper number, except when oxidation is conducted with less than 0·0064 atom of active oxygen per molecule of cellulose, when an increase in strength and copper number is obtained. —L.I.R.A.

Moisture, Hygroscopic, of Cereal Grains and Flax Seed exposed to Atmospheres of Different Relative Humidity. D. A. Coleman and H. C. Fellows. *Exp. Stat. Record*, 1926, **54**, 636 (from *Cereal Chem.*, 1925, **2**, 275-287).

Investigations in the grain division U.S. Department of Agriculture were concerned with the percentages of moisture in the commercial classes of corn, oats, barley, buckwheat, flax seed, rice, rye, and wheat, when exposed to atmospheres of approximately 15, 30, 45, 60, 75, 90, and 100% relative humidity at 25 to 28° C. Wheat appears to respond readily to changes in the humidity of the surrounding air, the rate depending entirely upon the conditions of exposure. Neither protein content nor the percentage of dark hard and vitreous kernels was correlated with the hygroscopic moisture. The hygroscopic moisture of samples of different market classes of wheat did not differ appreciably. The hygroscopic moisture in corn, oats, barley, buckwheat, rice and rye did not differ greatly from that of wheat. Flax seed contained appreciably lower percentages of hygroscopic moisture than the cereals studied. Hygroscopic moisture does not increase at a uniform rate when in equilibrium with increasing relative humidity of the atmosphere. Each increment of increase in humidity is accompanied by an acceleration in the rate of increase in content of hygroscopic moisture. The curve resulting from plotting humidity as abscissas against hygroscopic moisture as ordinates takes the form of a parabola. —L.I.R.A.

Silk: Tendering by Micro-organisms. J. F. Heyes and H. S. Holden. *J. Soc. Chem. Ind.*, 1926, **45**, 262T-265T.

A number of species of Aspergillus and other moulds were successfully grown on silk in different conditions. After growth periods of two months on silk dyed and tin-weighted there was found no perceptible tendering of the silk and no alteration in the colour of the dyes, except that caused by the development of coloured spores. Most species grow readily on the gum obtained from spun silk. In cultures using bleached, tin-weighted material, growth appeared to be much more difficult. Similar investigations with bacteria showed little evidence of growth except in the case of *Bacillus mycoides*. Several species appear to cause slight tendering in silk when incubated at 37·5°, but only *B. mycocides* causes any tendering at ordinary temperature. The dyeing properties are not affected by these bacteria. —B.C.I.R.A.

Cellobiose and Celtrobiose: Isomerism. C. S. Hudson. *J. Amer. Chem. Soc.*, 1926, **48**, 2002-2004.

When a chloroform solution of cellobiose octa-acetate is boiled with active aluminium chloride, there is formed in addition to the known α-chloroacetylcellobiose the chlorohepta-acetate of a new di-hexose, which is termed celtrobiose. —B.C.I.R.A.

Chrome Yellow: Precipitation. H. Wagner and E. Keidel. *Chem. Zentr.*, 1926, **i.**, 3574-3575 (from *Farben-Ztg.*, 1926, **31**, 1567-1573).

The paper is a study of the optimal conditions for obtaining good precipitation of chrome yellow. —B.C.I.R.A.

Hosiery Fabrics: Laddering. W. Davis. *Cotton*, 1926, **90**, 827, &c.

Laddering in knitted fabrics may be due to bad methods of manufacture. The quality of the needles used should be the highest. A good full texture is most resistant to laddering and spring needle frames provide a better fabric than latch needle machines. Two methods of producing non-laddering fabrics are indicated. In woollen knitted fabrics laddering is made more difficult by raising. —B.C.I.R.A.

Cell-membranes; Further Investigations of the Chemical Nature of the——. F. M. Wood. *Ann. Bot.*, 1926, **40**, 547-570.

The author describes a method for the detection of protein in the cell-wall by the liberation of iodine from potassium iodide after treatment of sections with chlorine gas and sodium hydrogen phosphate solution. Quantitative experiments indicated that not more than 0·001%, and probably less, protein occurs in the cellulose cell wall of the considerable number of plants experimented with. The amount of protein, if any, present in the cell wall is unlikely to interfere with cellulose and pectin reactions. —L.I.R.A.

Glycerin in Tobacco; The Detection and Determination of——. A. C. Chapman. *Analyst*, 1926, **51**, 382-386.

The method of determination involves the extraction of the material with acetone, separation of resins by extraction of the aqueous solution of the acetone extract with petroleum spirit and determination of the iodopropane produced on distillation with hydriodic acid. For the detection of glycerine the dihydroxyacetone and the α-naphthylmethane tests are described. —L.I.R.A.

Textile Fibres: Testing. *Vorschriften für das Öffentliche Warenprüfungsamt für das Textil-Gewerbe*, Chemnitz, 1921, 68 pp.

The official tests adopted by the Chemnitz Warenprüfungsamt for textiles, are published in pamphlet form. The tests, which are separately described for cotton, artificial silk, wool, linen and other fibres, embrace (1) conditioning tests, (2) measurements of count number or denier, (3) measurements of twist, tensile strength, and extensibility of yarns, (4) length, weight per unit area, thread density, tensile strength, &c., measurements of fabrics, (5) chemical tests, and (6) yarn and cloth analysis. —B.C.I.R.A.

Silk Breaking Load Regularity Tester. K. Tanahashi. *Silk J.*, 1926, **3**, No. 27, 46-47.

The instrument was designed to determine the evenness of raw silk thread by automatically recording the breaking load of the thread at 10-metre intervals. The thread is unwound from a bobbin by means of a thread catcher arranged at the upper end of a lever which reciprocates about its lower end. A 10-metre length is taken up by a second bobbin, the rewinding is temporarily suspended, and two thread holders arranged between the bobbins are made to hold a length of about 6 cms. The held thread is stretched and the stretching force is automatically recorded by a pen attached to one of the holders. When the thread breaks the holders return to their original positions, a further portion of thread is unwound, the record paper is moved slightly round the drum and the operation is repeated. —B.C.I.R.A.

Artificial Silk: Tendering by Acids. K. Wolfgang. *Kunstseide*, 1926, 8, 175-177.

Viscose, cuprammonium and nitro-artificial silks were tested under standard conditions with various dilute acids of concentrations ranging from 2% to 0·3%. The degree of tendering is measured by tensile strength tests made on the treated and untreated samples. The results indicate the following limit concentrations which can be used with safety on any of the three kinds of silk—Sulphuric acid 0·05%, formic acid 0·3%, acetic acid 0·3%, lactic acid up to 1% or even 1·5%. —B.C.I.R.A.

Indian Cottons: Spinning Tests. *Indian Central Cotton Committee Technological Laboratory Pamphlet*, 89 pp.

A short description is given of the spinning test procedure in the Technological Laboratory of the Indian Central Cotton Committee and the results of spinning tests on 15 standard Indian cottons are reported. The question of the minimum weight of cotton necessary for a trustworthy spinning test has been considered, for which purpose the cottons were generally tested in a number of lots having initial weights of 100, 10, 5 (2 lots), 42 (2 lots) lb. The tests indicate that trustworthy results can be obtained from samples as small as 5 or even 2 lb. in weight. As a whole, much the same results were obtained for any given type of yarn from each weight of sample. This conclusion applies to the range of counts possible with Indian cottons, i.e., up to 40's. —B.C.I.R.A.

Lignin in Wood and Wood Cellulose; Determination of——. W. J. Muller and W. Heerman. *Brit. Chem. Abs.*, B, 1926, 435 (from *Papierfabr.*, 1926, **24**, 185).

After dissolution of the cellulose by any of the known methods, the solution, containing the lignin in suspension, is filtered through a layer of finely-divided naphthalene in a glass or porcelain filter crucible. To prepare the filter a suitable volume (e.g., 10-20 c.c.) of a 5% solution of naphthalene in alcohol is poured into twice its volume of water and the paste thus obtained introduced into the filter, pressed down and washed. After use the naphthalene is sublimed over a water bath and the lignin is thus obtained pure and loose. —L.I.R.A.

Pectins; Decomposition of——. A. Mehlitz. *Brit. Chem. Abs.*, B., 1926, 418 (from *Konserven-Ind.*, 1926, **13**, 1-3).

If apple-pectin and pectin-sugar solutions are heated for 10 hours, 16% and 19·4% of their pectin-contents respectively are destroyed, mostly in the first few hours. In the latter case the decomposition is increased and decreased respectively by the presence of sugar or acid (produced in the initial stages), the high final value being due to the higher boiling point of the solution. When the duration of boiling is less than two hours, the decomposition of pectin is appreciably less in presence of sugar. —L.I.R.A.

The Dyehouse Laboratory. J. Ferguson. *Ind. Chem.*, 1925, **1**, 518.

All dyers, printers, &c., are recommended to create fastness tables for themselves, because the various figures adopted by "Schultz," "Colour Index," and "Sisley" do not agree. Many tables have been modified by the recommendations of the British Silk Research Association and other similar bodies. The use of the Fadeometer is recommended whereby the equivalent of 28 days' June sunshine in the North of England can be obtained in 52 hours or less. Tests have shown that the lamp tests are, with few exceptions, equal to those of sunshine. Efficient record cards are a necessity. —F.G.P.

Stressed Rubber: X-ray Structure. E. A. Hauser and H. Mark. *Kolloidchem. Beihefte*, 1926, **22**, 63-94.

The authors describe in detail their experimental investigation of the interference phenomena observed when stressed rubber is exposed to mono-chromatic Röntgen rays, which interference gives an impression of crystal interference. The measurements for the position, intensity, and distance of the interference points leads to the conception that, under tension, groups of molecules are formed in the rubber which contain 4,000-5,000 (C_5H_8) and show with respect to their structure a three-dimensional periodicity. The facts justify speaking of the formation of small crystals. The crystals exhibit very marked "heat motion," and under one-sided stress are all layered with one axis parallel to the direction of stress. Their period on this axis is about 7·68 Å. The crystals are certainly of quadratic forms. The paper is a full discussion of the structure of stressed rubber. —B.C.I.R.A.

Dye Solutions: Viscosity; and Colloid Particle: Size Determination. S. Liepatov. *Kolloid-Z.*, 1926, **39**, 230-236.

The viscosity of solutions of certain substantive dyestuffs which form emulsoid systems was studied, and the effect of temperature and electrolytes on viscosity determined. Electrolytes increase the viscosity very considerably, the increase in internal friction being a direct function of electrolyte concentration. There is an indication that a decrease in viscosity is accompanied by a decrease in the charge on the colloid. The approximate size of the hydrated particle of Geranin G and the thickness of the adsorption-water sheath are calculated. —B.C.I.R.A.

Colloidal Solutions and Plastics: Consistency. W. H. Herschel and R. Bulkley. *Kolloid-Z.*, 1926, **39**, 291-300.

The authors express the flow properties of plastic substances (in which rate of flow is not proportional to pressure) by the term consistency, and examine the consistency of solutions of raw bleached crepe rubber in benzene prepared in the way described. An equation is derived for the flow of the plastic in terms of the diameter and effective length of the capillary, effective pressure, and time of flow. The formula is applicable to rubber solutions in concentrations up to 1·2%; it is valid for practically all flow velocities and does not necessitate very high pressures. The method of measuring the material constants and the capillary dimensions is shown in detail. —B.C.I.R.A.

Shearing Modulus and the Relaxation of Some Sols: Examination of the——. E. Matschek and R. S. Jane. *Kolloid-Z.*, 1926, **39**, 300-313.

The shearing modulus of a number of sols of gelatine, ammonium oleate, mercury sulphosalicylate, cotton yellow, and benzopurpurine have been determined by the Schweddoff method. The modulus increases with age in all cases, except that of very unstable ammonium oleate. With rising temperature it falls rapidly and in the cases considered the modulus is very small at temperatures about 40°. In a number of cases the Maxwell time relaxation periods have been determined and from these and the moduli, the viscosity coefficient was found to be of the order of 10^2-10^4 absolute units. The rate of decrease in the twist of the torsion wire was measured and from it a simple equation was found giving the coefficient of viscosity. The values so obtained agree fairly well with those obtained by the Maxwell method. It was found that both elasticity and viscosity of the substances used depend very largely on the previous history of the substance. —L.I.R.A.

Swelling of Textile Fibres. E. Justin-Mueller. *Chem. Abs.*, 1926, **20**, 1933 (from *Kolloid-Z.*, 1925, **37**, 239).

"Turgoids" are organic substances which in the presence of H_2O swell without going into solution and include textile fibres, unhaired skins, &c. The turgescence of cotton, wool, and silk fibres as measured by a turgometer was found to increase or decrease with hydrate formation.

—B.L.R.A.

Soap Solutions: Viscosity. K. S. Malik. *Kolloid-Z.*, 1926, **39**, 322-324.

The author employs Mata Prasad's viscosity measurements of sodium stearate and sodium palmitate in organic solvents to test the validity of the three equations connecting viscosity and concentration proposed by Einstein, Hatschek, and S. Arrhenius. The effect of temperature is also introduced. The tables of measured and calculated coefficients show that Einstein's equation gives low viscosity values; that the logarithmic equation of Arrhenius is applicable to aqueous solutions of sodium stearate and palmitate, but that the calculated value of Θ is very different from Arrhenius' value. The value of the constant decreases with decreasing concentration of dissolved substances. For equal concentrations it is in general greater at lower temperatures.

—B.C.I.R.A.

Wetting Agents: Wetting Power and Surface Tension. P. Krais and H. Gensel. *Leipzig. Monats. Text.-Ind.*, 1926, **41**, 237-238.

The authors determined the relation between surface tension and wetting power of 11 commonly used proprietary wetting agents at different temperatures. Surface tension was measured by Traube's Stalagmometer method and wetting power by measuring the sinking time of 3·5 cm. lengths cut from a 15's Egyptian yarn, in 0·5% to 2% solutions of the wetting agent. The results show that the surface tension and the sinking time both decrease with increasing concentration of the wetting agent (except one brand); relatively short sinking times are generally only obtained when the concentration is not below 1%. The wetting agents which reduce the capillarity constant of water most, accelerate sinking best. It was found that above 20° the temperature has no appreciable effect on the surface tension. The sinking time increases with decreasing temperature. —B.C.I.R.A.

Sulphite- and Soda-Celluloses: Differentiation. *Mitt. Materialprüf.*, 1926, **2**, 38.

Two methods of differentiating between sulphite cellulose and soda cellulose in paper are discussed. The method of Lofton and Merrit consists in staining the pulp with a definite mixture of fuchsin and malachite green solution on a microscopic slide and then treating with acid. The method of Wisbar which is a modification of the above is carried out by staining with the same dyestuff mixture, but with dilution of the solution and simultaneous addition of hydrochloric acid in a reagent glass. By the Lofton and Merrit method, sulphite cellulose is stained purple red, soda cellulose reddish-violet. By the Wisbar method the sulphite cellulose becomes reddish-violet, the soda cellulose greenish-blue. The reason for the different quantitative results obtained by the two methods is discussed. When small quantities of sulphite cellulose are involved the Wisbar modification is to be preferred.

—B.C.I.R.A.

Crystals: X-ray Analysis. Sir William Bragg. *Nature*, 1926, **118**, 120-122.

A simple exposition of the methods of X-ray analysis of crystal structure, illustrated by diagrams given by a crystal of cane sugar in rotation, asbestos, and ramie fibres, and aluminium foil. —B.C.I.R.A.

Perborates: Catalysed Tendering Action. Y. Dalström. *Papier-Fabr.*, 1926, **24** (Verein Zellstoff Ingenieure Section), 523 (from *Svensk Kem. Tidskr.*, 1926, **4**, 96).

Copper and iron compounds exert no catalytic action if fibres are washed repeatedly with perborate solution, but if the fibres are boiled in pure concentrated perborate solution, copper and copper+iron compounds have a high tendering action. The tendering caused by copper or copper+iron compounds can be prevented by adding a sodium salt of a fatty acid. Iron compounds alone have no appreciable tendering action. —B.C.I.R.A.

Flax Wax; The Constants of——. W. Honneyman. *Pharmaceutical J. and Pharmacist*, Aug. 7th, 1926.

Flax wax has been prepared from flaxes grown under various climatic conditions and retted by different methods. The analytical constants determined show that these differences do not appreciably affect the wax produced by the plant. Hemp wax has also been prepared, and its analytical constants given. —L.I.R.A.

Dried Gelatin: Stress Distribution. W. Goedecke. *Physikal. Ber.*, 1924, **5**, 152-153 (from *Dissertation, Erlangen*, 1923).

A distinction should be drawn between regularly distributed stresses which occur in gelatin on shrinking and irregularly distributed stresses. The first may be measured by the bending of a metal plate on which a gelatin film shrinks on drying, or by the deformation of a wire by a shrinking film. The irregular stresses, which occur in the latter stages of drying, assume very high values. They determine the great brittleness of dry glue and explain the flying off of glass particles from glass surfaces on which glue shrinks in drying. The phenomenon finds explanation in researches on the elasticity modulus of gelatin dried under tension. —B.C.I.R.A.

China Clay Particle: Size Determination. G. Fischer. *Physikal. Ber.*, 1926, **7**, 1111 (from *Jahrb. Philos. Fak. Würzburg*, 1921-22, Pt. II., 9-11).

The aim of the work was to measure absolutely the size of the particles occurring in kaolin and then to establish quantitatively their percentage distribution in the different varieties of kaolin. The method is essentially a fractional elutriation process. An appropriate precipitating liquid was looked for and it was sought to remove difficulties due to the effect of temperature and of air bubbles, and to arrange for the regular rise of the elutriating liquid to the surface of the precipitation liquid. The apparatus, which is described, always effects a two-part fractionation. From the curves obtained the order of magnitude of the particles can be deduced. The "mean particle sizes" lie with their diameters between $8{\cdot}26\times10^{-4}$ and $3{\cdot}6\times10^{-4}$. These unexpectedly large surface dimensions allow of the interpretation of many physical phenomena in kaolin as manifestations of surface activity. —B.C.I.R.A.

Gelatin Solution: Elasticity and Swelling Effect. L. Ringelmann. *Physikal. Ber.*, 1924, **5**, 153 (from *Dissertation, Erlangen*, 1923).

Researches on the elasticity of gelatin solutions indicate that the relation found by Leick between elasticity modulus and concentration is only a first approximation. Following the time change leads to the important result that within a change of concentration of 5 to 50%, coagulation follows a course independent of the concentration. Swelling experiments indicate as the most important result that the swelling process cannot be regarded as a solution process alone, since the same amount of water taken up by solution at higher temperatures and in swelling at lower temperatures affects the elasticity modulus in different ways. —B.C.I.R.A.

Crystals: Single, of Aluminium under Static and Repeated Stresses. H. J. Gough, D. Hanson, and S. J. Bright. *Science Abs.*, A., 1926, **29**, 587-588 (from *Roy. Sci. Phil. Trans.*, 1926, A., **29**, No. 226, pp. 1-30).

Shows that the single crystals of aluminium possess no primitive state of elasticity; plastic strain occurs under the lowest stresses applied. This plastic strain consists of shear in the direction of a principal line of atoms on one or more of the octahedral planes of the crystal. The slip-bands which appear on the polished surfaces are the traces of these planes. The effect of slip on any plane is at first to increase its resistance to further slip; at the same time a similar hardening effect is produced on planes parallel to the original slip-planes and to a greater degree on planes intersecting the original slip-planes. Extension always taking place under reversed stresses suggests that the resistance to slip on any plane is greater when the normal stress across the plane is compressive than when it is tensile. Apart from this effect, slip in any part of a specimen appears to be confined to that octahedral plane on which the shear stress in one of the principal atomic directions is the greatest. The hardening effects in the crystals appear to be connected with a permanent distortion of the lattice of the crystal. The present work does not confirm the suggestion that this distortion may be a uniform bending of the crystal planes. —L.I.R.A.

China Clay: Moisture Relations. E. Zepler. *Physikal. Ber.*, 1926, **7**, 1133 (from *Jahrb. Philos. Fak. Würzburg*, 1921-22, Pt. II., 12-14).

The physical behaviour of a series of kaolins towards water was investigated, the properties examined being permeability to water, rate of suction, water absorption, rate of drying, resistance to fracture, and absorption of water vapour. The view taken by Stark that essentially the behaviour of kaolins may be determined by their particle size is entirely confirmed in the case of the foregoing properties. Fischer's series of particle sizes of different kaolins is obtained anew. The coarsest kaolins have the greatest permeability, rate of suction and of drying, and the quickest water absorption, and have on the other hand the smallest drying shrinkage, resistance to fracture and water vapour absorption. The other kaolins up to the

finest follow in general the above-mentioned series. If a kaolin falls outside, the fact is explained by "internal" forces predominating in the surface of the particle. —B.C.I.R.A.

Water: Viscosity. A. Griffiths and P. C. Vincent. *Proc. Phys. Soc.*, 1926, **38**, 291-301.

A method is described of determining the coefficient of viscosity of water by measuring the rate of convective flow in a long capillary tube, the driving head being obtained by the difference in density due to a difference of temperature between two vertical columns of water. The results are in agreement with a previous conclusion, namely, that the viscosity of water at low rates of shear in glass tubes is apparently no different from that at high rates. The novel features of the paper are (1) the method of obtaining the driving head so as to maintain very low rates of flow, (2) a new method of introducing a coloured index in a closed capillary circuit, and an improved method of reading its position involving the use of two incandescent lamps, (3) an almost complete elimination of the "thermometric" as distinct from the "convective" effect, (4) the elimination of the small thermometric effect from the final conculations. —B.C.I.R.A.

Means of Identification of Rayon Yarns. *Silk* (N.Y.), 1925, **18**, No. 9, p. 35.

Burning test—Cotton burns with a flash, little odour, no ash, silk burns slowly, odour of hair, black ash; wool burns slowly, odour of hair, brittle ball of ash; viscose, nitro-cellulose, and cuprammonium rayons burn with a flash, no odour, no ash; acetate rayons burn slowly and leave a globule of ash that becomes brittle like sealing wax. Concentrated sulphuric acid mixed with iodine gives fairly distinctive colours with different rayons. Under the microscope, viscose fibres show marks like the bark of a tree and are more like ribbons than cylinders; acetate is like glass rods, nitro-cellulose is smooth, fairly regular, and silvery; cupram. is not so transparent as the others but is very regular. Cross sections of the fibres are also fairly distinctive. Figures of these are given. —F.G.P.

Yarn: Breaking Load Irregularity. (1) A. Lüdicke. (2) —. Schweiger. *Melliand's Textilber.*, 1926, **7**, 522-523.

(1) Further to his own conclusions, Lange's article indicates that, in order to obtain authentic results, the experiments should be continued until the mean shows no essential fluctuation. This point is determined by finding the mean of every ten experiments and continuing the experiments until the figure remains constant.

(2) In interpreting the results of breaking load tests, this author adopts a method in which he determines the mean of the whole series of results and the lowest breaking load. The difference of these values is the deviation in grams, which is converted to percentage deviation. He is of the opinion that the weakest point is the deciding factor in determining the value of a yarn. Experience has shown that a yarn having a percentage deviation up to 15 calculated by this method is very good, 15-25% is good, 25-35% is moderate, and above 35% is bad. For the figures quoted by Lange, the deviation is 28%, and the yarn is therefore "moderate," whilst according to the methods in which the sub-mean is employed the yarn would be classified as very uniform. —B.C.I.R.A.

Yarn: Breaking Load Irregularity. H. Schlömer, jr. *Melliand's Textilber.*, 1926, **7**, 434-436, 517-521.

A comparison is made of various methods of interpreting the results of breaking load measurements, including the formulæ of Sommer, Marschik, Roscher, and Schlömer. The ratio (mean—sub-mean)/arithmetic mean of 10 results is shown to give no indication of the true irregularity of a yarn and the graphical method of interpretation, plotting single values or group means, is recommended as giving a more significant expression of irregularity or regularity than can be obtained by calculation. —B.C.I.R.A.

Crimp Measuring Machine. H. Hartley. *J. Text. Inst.*, 1926, **17**, T254-258.

Test for Mercerised Cotton. H. Mennell. *J. Text. Inst.*, 1926, **17**, T247.

Recording Extensometer. T. Lonsdale. *J. Text. Inst.*, 1926, **17**, T248-253.

Ballistic Test of Yarns for Work of Rupture. E. Midgley and F. T. Pierce. *J. Text. Inst.*, 1926, **17**, T317-329. —L.I.R.A.

Damaged Cotton Hairs: Testing. T. B. Bright. *J. Text. Inst.*, 1926, **17**, T396-T404.

PATENTS

Daylight Filter: Specification. A. R. St. Clair, Whitley Bay, Northumberland. E.P.255,235.

The light filter described in Specification 234,530 has the red component between 0·05 and 0·50 according to Lovibond's tintometer. For colour matching a tint having the following analyses—Blue 4·10, red 0·20, is used, and for certain colours, for example green, a small proportion of yellow is advantageous, which may be between 0·05 and 0·10. —B.C.I.R.A.

Adhesive Tape Testing Machine. W. W. McLaurin, Brookfield, Mass. E.P. 255,298.

In means for testing gumming or sealing tape and other adhesive strips of paper, cloth, or other flexible materials, a strip to be tested is moistened and caused to adhere either to two plates of material similar to that for which the strip is intended to be

used, or else to such material carried as a covering by metal plates. By screw-clamping means, the plates are held between pairs of jaws, the lower jaws forming the ends of arms mounted on pivots and extended rearwardly as scale-bearing arms carrying sliding weights. These weights are moved gradually outwards and the point at which slip occurs at the joint formed by the strip is noted. —B.C.I.R.A.

7—BUILDING AND POWER

(A)—Construction of Buildings

Refrigerating Machinery. *Engineering*, 1926, **122**, 205-206.

At the 1926 meeting of the British Association a paper was read by Prof. C. M. Jenkin entitled "Small Refrigerating Plants." The essential features of the vapour-compression and absorption types of plants were dealt with and charts were exhibited referring to the performance of the principal refrigerants. Several types of machines were described, among them being those made by the Delco Light Co., Messrs. R. Crittal & Co., and the General Electric Co. The first of these employs sulphur dioxide and comprises a single cylinder compression driven by a motor and an air-cooled condenser. This machine uses a large number of mechanical joints. The second machine uses ethyl chloride and is entirely enclosed in a metal case. In the General Electric Co. machine the whole of the refrigerating elements are contained in sealed enclosures. The machine is in the form of a dumb-bell, one side comprising the evaporator and the other the condenser which contains the compressor. The compressor is mounted on the shaft and held vertical by balance weights. An eccentric on the shaft operates the pistons and connection with the evaporator is made through the shaft which is hollow. A stream of water flows through the condenser, but only a slow rate of flow is needed. The machine is suitable for oil cooling or air drying. —L.I.R.A.

Steel for Shelving. J. F. Springer. *Silk* (N.Y.), 1926, **19**, No. 3, p. 38.

Among the advantages of steel shelving in silk stores are—Greater strength, greater capacity, less fire risk, no splintering, easy moving, and improved system and order. Units with varied arrangements of shelves are obtainable. —F.G.P.

Special Flooring. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 10, p. 37.

The material described is diamond plates of cast-iron in which is embedded coarsely powdered carborundum. It is stated to prevent slipping even when coated with oil, it will not disintegrate on exposure and with ordinary traffic will outlast the building. —F.G.P.

The Floor Problem. J. F. Springer. *Silk* (N.Y.), 1925, **18**, No. 10, p. 39.

The material described is a mixture of suitable asphalts with a well-graded mineral aggregate. It may be laid from ¾ in. to 3 in. thick on a solid foundation of wood or concrete. It is said that heavy truck traffic does not damage it, hard knocks merely cause dents which flatten out again and it does not wear away. In a modified form it is acid-resisting for dye-houses and plating-rooms. It is noiseless, resilient, and non-absorbent. It is easily laid and ready for traffic in about three hours. —F.G.P.

(C)—Power

Textile Water Supplies; Engineering Aspects of Treating——. H. L. Tiger. *Chem. Abs.*, 1926, **20**, 2217 (from *Mech. Eng.*, 1926, 48, 435).

A general description is given of chemical feed apparatus, settling tanks, filters and water softeners for treatment of the water supply of the textile industry. Removal of hardness by zeolite softeners is recommended because sodium salts do not react with the soap or dyestuffs. Excess of soda, ash, and lime, necessary for complete removal of hardness by the lime-soda process, is highly undesirable in this industry. Care must be taken to prevent contamination of the water by algæ from open reservoirs or iron or organic matter after treatment. —L.I.R.A.

Springs: Construction. J. K. Wood. *Mech. Eng.*, 1926, **48**, 808-814.

American specifications for large helical springs for railway work, and spring material specifications are discussed in the first part of the paper. In the second part the author deals with the material and manufacture of small springs, and draws up a specification for a steel helical compression spring to be operated under a continual load that is to be oscillated about one million times in about five years. The author introduces the idea of a "load deflection sector" to replace the load-deflection curve and employs this in framing his specification. —B.C.I.R.A.

Dyehouse: Steam Consumption. F. Urbanczyk. *Melliand's Textilber.*, 1926, **7**, 643-645.

The uneconomic conditions of steam utilisation which may exist in dyehouses are discussed with the aid of diagrams and it is shown how, by distributing the work between morning and afternoon so that the boiler is fairly uniformly loaded throughout the day, considerable economy can be effected without the installation of a steam accumulator. Higher production, economy of fuel, and consequently lower production costs, and better goods are claimed for the arrangement or, for the same production a smaller boiler plant, lower up-keep costs and better goods. —B.C.I.R.A.

(D)—Lubrication

Lubrication Problems in the Silk Mill. T. W. Feeley. *Silk* (N.Y.), 1926, **19**, No. 3, p. 38.

Save the drops and stop the spots; 50% of spots on goods arise in throwing where open slot bearings of the spindles allow oil to leak out and spatter the swifts. A white grade of non-fluid oil should be used, and also in the crosshead drives. The fingers of the operators are less liable to become oily under these circumstances. Ordinary oil is also liable to leak out of the main bearing next the brake-band of looms, and spatters may arise from the dobby. All these and similar troubles may be stopped by non-fluid oil. —F.G.P.

(F)—Lighting

Saw-tooth Roofs: Effect on Lighting. W. C. Randall. *Sci. Abstr.*, 1926, **29B**, 283 (from *Trans. Amer. Illum. Eng. Soc.*, 1926, **21**, 241-272).

Saw-tooth construction in industrial buildings has chiefly been used to avoid the admission of direct sunlight. On the premise that the windows should be sloped to obtain more light, the problem is to find the greatest slope that can be used so that direct sunlight will not enter under given conditions. The solution is presented, with typical examples, taking into account the various connections which may have to be made. Due to the lack of information of the effect on illumination on the working plane of such elements as the height of windows, slope of windows, the span and the condition of the inside reflecting surfaces, an analysis has been made of these factors. The effect on illumination of such elements as the kind of glass used, glare reducers, &c., is also discussed. —B.C.I.R.A.

Lighting. J. Ondracek. *Sci. Abstr.*, 1926, **29B**, 282 (from *Elek. u. Maschinenbau* (Lichttechnik), 1926, **44**, 9-13).

The author suggests as a figure of merit of an illumination system the mean flux density, irrespective of direction, at a point. The diffuse component can be deduced from Mascart's law for the flux density inside an enclosure of given reflection factor. The direct component can be calculated from the position and nature of the light sources. An expression for the total is given and its application to determine the excellence of a lighting system is described. —B.C.I.R.A

Osram Point Light Lamp. E. Hochheim and E. Knebel. *Melliand's Textilber.*, 1925, **6**, 912-914.

The lamp is gas-filled and has two hemispherical tungsten electrodes in contact. A bimetallic strip in the cathode is heated by the passage of a current and withdraws the cathode from the anode so that an arc is produced between the electrodes. This lamp differs from light sources hitherto in use in that the spectral composition of its light approximates very closely to that of sunlight. The spectrum is continuous to about 300 $\mu\mu$. Comparative experiments on the fading of 48 dyed samples show very good agreement, both in actual bleaching and in change of tone, in the effect of sunlight and the tungsten arc lamp. The dyed samples were placed round the lamp at a distance of 15 cm. from its centre point. —B.C.I.R.A.

(G)—Heating

Surface Pyrometer. M. W. Boyer and J. Buss. *J. Ind. Eng. Chem.*, 1926, **18**, 728-729.

A portable thermocouple device for measuring surface temperatures is described. The device is compensated for heat losses from the thermocouple by applying to its exposed side sufficient heat to prevent any heat flow through it. —B.C.I.R.A.

(H)—Humidification

Cotton and Artificial Silk: Regain and Strength. J. Obermiller. *Melliand's Textilber.*, 1925, **6**, 818-819.

In a lecture dealing with the importance of controlling the air humidity of textile process rooms, the author referred to curves which he has obtained from experiments on fibres lasting continuously over two years and carried out at a temperature of 20° and at 6-7 different degrees of air humidity. The curves, which cover relative humidities of 0% to 100%, show that in absolutely dry air the fibres completely lose their moisture and that at 100% relative humidity they are laden with amounts of water which in wool, silk, cuprammonium or viscose artificial silk and cotton appear to exceed 32%, 35%, 40% and 26% respectively calculated on the dry weight of the fibre. Experiments to test the dependence of fibre moisture on temperature show that the equilibrium between fibre moisture and relative humidity is only dependent to a negligible extent on temperature. The following relative "wet strengths" are recorded—

Cotton	110-120%
Wool	80- 90%
Silk	75- 85%
Acetate silk	65- 70%
Cuprammonium silk	50- 60%
Viscose silk	45- 55%
Nitro silk	30- 40%

—B.C.I.R.A.

Artificial Silk Filaments: Extension with Humidity. A. Oppé and K. Götze. *Melliand's Textilber.*, 1925, **6**, 850-854.

The changes in length in threads of a number of artificial silks were measured at relative humidities of 0%, 35-40%, and 83%. The apparatus described consists of a graduated glass tube of about 60 cm. in length provided with two side tubes for circulation of air. The top is closed by a

stopper from which the thread is suspended; to the bottom is attached by rubber tubing a small test tube which carries two upright pieces of glass rod standing in wax at the bottom of the tube. The end of the thread is loaded by a rectangular piece of paper of 0·3 gm. in weight, which is prevented from rotating by the glass rods. The test tube can be moved up the graduated tube so that the card can rest on the wax bottom and the thread be released from load. A definite length of thread is marked off for observation by making two knots at a given distance apart. Length readings under load were taken in the order (1) in air of normal humidity, (2) in damp air, (3) in dry air, (4) in air again of normal humidity. Readings (1) and (4) were always constant. Length changes are tabulated for viscose, nitro, cuprammonium, and acetate artificial silk of different origins. For viscose artificial silk threads the extension varies from 0·6-0·8% for a rise in relative humidity of 0% to 35%, and from 1·1-1·5% for a rise in relative humidity of 0% to 83%. The results obtained for acetate artificial silks are little different from those obtained for viscose threads in spite of the known different water-resisting powers of the former. —B.C.I.R.A.

Humidification. W. Bergmann. *Melliand's Textilber.*, 1926, **7**, 595-596.

In a short note on the control of temperature and humidity in the textile industry and the advantages of the unit system of humidification, the following temperatures and humidities are quoted as the most favourable for the processes named—Mixing and scutching rooms, 22° C. and 35-40%; card room, 24° and 45%; mule spinning shed, 26° and 70%; ring spinning shed, 26° and 60-65%; reeling room, 28° and 75%; packing room, 22° and 80-90%. —B.C.I.R.A.

Electric Telehygrometer: Application. C. Krafack. *Melliand's Textilber.*, 1925, **6**, 938-939.

Bongard's recommendation of the hair hygrometer for measuring humidity is adversely criticised. The author has made comparative experiments, extending over several months with an electric psychrometer, a hair hygrometer, and an ordinary ventilated psychrometer. The measurements are not yet complete but the hair hygrometer has frequently shown considerable errors which have not been shown by the electric psychrometer. In the new telehygrometers, evaporation of the water at the junctions of the one series of thermo-elements is induced by porous clay tubes, the porosity varying with the temperature for which the apparatus is to be predominantly used. The water is led in from above. The apparatus can be used for all kinds of humidity measurements and for estimating the amount of vapours such as benzene, petrol, ether, and alcohol in air.

—B.C.I.R.A.

(I)—Ventilation

Dust Filters. *J. Soc. Chem. Ind.*, 1926, **45**, 177-188T.

The article deals with dusts, clouds, and smokes and with their treatment and removal. The pathological results of inhaling dusts are described and preventive measures briefly discussed. —B.C.I.R.A.

Weaving Shed: Ventilation. S. Wyatt, J. A. Fraser, and F. G. L. Stock. *Ind. Fatigue Res. Bd.*, Report No. 37, 1926, 33 pp.

The pamphlet is a report of an experimental study of fan ventilation in a humid weaving shed. The main results are summarised as follows—The cooling power of the air and bodily comfort of the operatives were considerably increased by the particular arrangement of fans adopted. The average rate of air movement in a representative position was increased by the fans from 46 to 147 ft. per minute. This produced an increase in the dry kata-thermometer rate of cooling of 33%, while the evaporative power of the air on moisture at body temperature was increased by 29%. Without fans the cooling power of the air never reached the minimum standard considered necessary. By running the fans at different speeds according to the atmospheric conditions in the shed, it was possible to obtain a fairly uniform rate of cooling up to a temperature limit of 85°. Smaller fans effective over the area occupied by four looms were equally satisfactory. The increased air movement produced by the fans had no significant effect on the number of warp breakages on the looms in their vicinity. The number of warp breakages decreased as the relative humidity increased and as the temperature increased. The highest output was obtained when the temperature was from 72·5° to 75° F. and the relative humidity 75 to 80%.

—B.C.I.R.A.

Patents

Humidity Recorder. E. S. Shoults, Hoddesdon, Herts., J. G. Murray, W. Norwood, London, and W. G. Smith, Chelmsford, Essex. E.P.254,507.

Apparatus of the kind in which an indication or record of humidity is obtained from the change of weight of a substance which absorbs moisture is provided with means for setting it up in the same position in relation to the horizontal as that in which it was calibrated. A form of indicating apparatus is shown in which the absorbent material is suspended from an arm secured to a spindle carrying a pointer and controlled by weights or a spring. Clamping means is provided and also a level or plumb line for showing the position in which the instrument is to be set up. The pointer may be arranged to co-operate with fixed electric contacts so as to operate an alarm,

&c., at predetermined values of humidity. In a modification, the movement of the absorbent is controlled by a magnetic field, and in another it is arranged at the end of a helical spring, the extension of which indicates the humidity. Specification 24,159/01 is referred to. —B.C.I.R.A.

8—DESIGN

Sateen Weaves: Designing. F. Müller. *Melliand's Textilber.*, 1926, **7**, 502-504.

An article on the design of sateen weaves and variations of the type. Point paper diagrams of some sateen weaves are reproduced. —B.C.I.R.A.

Drills and Damask: Designing. J. Funke. *Melliand's Textilber.*, 1925, **6**, 894-895.

A note on drills, damasks, and similar materials in which warp and weft weaving patterns are introduced. It is important that the interlacing of the warp and weft threads is such that they will keep their places in the finished material. The author has found that the possible ways of carrying out any given weave can be ascertained by grouping the binding points symmetrically round the centre point of the repeat in point paper diagrams and gives examples of 3-, 4-, 5-, 6-, 7-, and 8-end twills and 5- and 6-end sateens. Three-end twill can only be made in one way, 4-end twill has three possible alternatives and 5- and 6-end twill and sateen four alternatives. —B.C.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Indian Cotton Cultivation. *Indian Central Cotton Committee*, 12th meeting. Abtract Proceedings, pp. 67.

An abstract of the 12th meeting proceedings of the Indian Central Cotton Committee is given, particular items of interest including—(1) The proposal to extend the operations of the Transport Act to the Broach Tract north of the Narbada; (2) the addition of loose or half-pressed cotton figures to the mill consumption statistics; (3) the organisation necessary for the inquiry into the financial position of the growers; and (4) the import of East African cotton into Kathiawar ports and the danger of Red Bollworm introduction; in all of which action was approved. Progress is reported in conducting spinning tests on the 17 standards and on pure strains. Data as to the acreage of pure seed on the seed farms and among the native holdings are given in an appendix. —B.C.I.R.A.

Cotton Cultivation in Nigeria. C. N. French. *Emp. Cotton Grow. Corporation*, Report 1926.

An account of cotton growing organisation and of general agricultural administration in North and South Nigeria with recommendations for increasing the staff and for improving essential services. —B.C.I.R.A.

Cotton Production in Southern Rhodesia. *Emp. Cotton Grow. Rev.*, 1926, **3**, 287 (from *Rhodesian Agric. J.*, 1926, **23**, 112).

Acreage and yield statistics are given by districts for 1924-25. —B.C.I.R.A.

Weavers: Selection of——. J. A. Fraser. *J. Nat. Inst. Ind. Psychol.*, 1926, **3**, 162-165.

Physical and mental characteristics required in efficient weaving operatives are deduced from statistical data obtained from three-loom weavers producing high quality cloth. For maximum speed, the weaver should possess, in addition to normal fitness and intelligence, delicacy of touch, muscular dexterity and co-ordination and a power to distribute attention over a fairly wide area. —B.C.I.R.A.

Cotton in the U.S.A.: Co-operative Marketing. G. O. Gatlin. *U.S. Dept. Agric. Bull. No.* 1392, pp. 48.

A succinct account of co-operative cotton marketing in the U.S.A. describes the high degree of efficiency now reached by the co-operative organisations. The constitution and the progress of the Cotton Growers' Exchange and of each of the separate associations is discussed. An interesting chapter on principles and policies deals with agreements, contracts, membership, democratic control, management, large-scale organisation, orderly marketing, merchandising, pooling, &c. Methods and practices cover problems of delivery warehousing, insurance, sampling, classing, financing, distributions, credit, selling, and accounting. The Field Service organisation and the constitution of the Cotton Growers' Exchange are diagrammatically represented. —B.C.I.R.A.

Ironers and Folders: Fatigue Investigation. S. Wyatt and J. A. Fraser. *Reports of the Ind. Fatigue Res. Bd.*, 1925, No. 32, 39 pp.

Studies in repetitive work with special reference to rest-pauses are reported. The results are based on observations of 16 workers in four factories over periods of 15 weeks. The conclusions reached are that the introduction of a rest of ten minutes about the middle of the spell of work caused (*a*) an increase of 1·5 to 8·0% in the net rate of working; (*b*) in many cases, an increase in total output. In handkerchief folding the actual increase was 2·3%; in handkerchief ironing, 1·6%; (*c*) a reduced variability in the time taken to repeat the same cycle of movements as the end of the spell approached; (*d*) a reduction in the amount of time lost within the spell of work. The subject is discussed at some length. —B.C.I.R.A.

Cotton Trade Statistics for India. W. D. M. Clarke. *Bd. Trade J.*, 1926, **117**, 223-226.

An extract from a Consular Report showing in detail the Indian import and export

trade in cotton yarns and piece goods and in raw cotton for the year 1925. —B.C.I.R.A.

Government Textile Institute, Madras. *Indian Text. J.*, 1926, **36**, 277-279.

The Government Textile Institute, Madras, which provides training in all branches of the cotton and silk industries, is described. The economic difficulties confronting the Indian hand-loom weaving industry are discussed. —B.C.I.R.A.

Flax Acreage in Lithuania. *J. Dept. Lands and Agric.*, 1926, **26**, 68.

Statistics are given to show that the area under cultivation in Lithuania shows an increase of 10% as compared with pre-war times, notwithstanding the complete devastation of the country during the war. The average acreage of flax for 1909-1913 was 138,000, whilst in 1925 it had risen to 190,000 acres. The yield of fibre in cwt. per acre is given as 4·3 for 1924 and 4·7 for 1925. —L.I.R.A.

Cotton Mill: Mechanical Supervision. *Mech. Eng.*, 1926, **48**, 746-748.

In the discussion on a paper on fundamental measurements in a cotton mill, the need for better organisation and supervision in American mills is emphasised. —B.C.I.R.A.

Artificial Silk: Production. O. Wilson. *J. Ind. Eng. Chem.*, 1926, **18**, 829-831.

In a general article on the position in the artificial silk industry the world's production by countries is given for the year 1925. Brief notes are given regarding the capital and output of the chief manufacturers. —B.C.I.R.A.

New British Rayon Factories. *Silk J.*, 1926, **2**, No. 22, p. 42.

An Italian firm is negotiating for a 20-acre site at Darlington for the erection of a rayon factory. At Balymena, Co. Antrim, a State-aided rayon plant is to be erected; the government subsidy is to be £125,000. It is expected that several hundred out-of-work linen weavers, &c., will be employed. —F.G.P.

Phenomenal Growth of Rayon. *Amer. Silk J.*, 1926, **45**, No. 2, p. 34.

It is recalled that in 1904 Lansdowne, the organiser of the first rayon factory in America, went bankrupt and the only bid received for his patents was one of $2,500. These patents controlled the output of viscose in the States. This year the total output of rayon in America is estimated to be 80,000,000 lb., a phenomenal increase in less than a quarter of a century. —F.G.P.

Recent Developments in Rayon. S. A. Salvage. *Amer. Silk J.*, 1926, **45**, No. 2, p. 37.

Rayon laboured for years under the handicap of a misnomer of "artificial silk," even though it has none of the characteristics of silk, and buyers regarded it as a destructive force assailing the position of silk. This fallacy is exploded and the fundamental differences between the fibres, together with the changed name, have enabled rayon to take its proper place in the textile world. Rayon has strengthened the position of silk, wool, and cotton by the creation of new combination fabrics, more attractive and of reasonable price. Every mercantile house will soon have a rayon department as it has departments for other textiles. The figures of the output of rayon look like those of an European war-debt to America. —F.G.P.

Technical Training and Textiles. *Amer. Silk J.*, 1926, **A5**, No. 2, p. 47.

The question is raised as to whether the silk industry is a field for college-trained men and the British Textile Institute is cited as an example of what should be done in America towards obtaining trained minds to work upon the problems which arise. In Great Britain the textile industry and the Government spend millions annually on pure research, maintaining huge laboratories and procuring the foremost chemists. In America they depend on skilled British, French, and Swiss scientists and workmen to run their mills. —F.G.P.

Artificial Silk Developments. *Chem. Age*, 1926, **15**, No. 382, p. 395.

As a result of the 1925 boom, production of rayon is commencing in several parts of the country. Factories at Tottington (Lancs.) and Gloucester are producing viscose. At Aintree a works was opened, in October, with a capacity of 20,000 lb. of viscose a day. Two other factories will be running in the near future. At Stowmarket nitrocellulose and viscose are being made, and another large acetate works is to be commenced shortly. —F.G.P.

Artificial Silk in Canada. *Chem. Age*, 1926, **15**, No. 382, p. 398.

Canada supplies the wood pulp to many countries for making rayon. In 1922 a Government report pointed out the very favourable conditions for local manufacture. In 1924 Courtaulds, Ltd., established a viscose factory in Cornwall, Ontario. Canadian Cellulose, Ltd., is now building a $7,000,000 plant in Quebec. There are other factories in Ontario and British Columbia. Hemlock is largely used, and the plentiful supply together with large natural power resources makes the outlook very hopeful. —F.G.P.

International Dyestuffs Situation (Artificial Silk). W. J. U. Woolcock. *Chem. Age*, 1926, **15**, No. 383, p. 427.

The production of rayon for 1925 is given as—America 50 million pounds, England 30, Italy 28, Germany 26, France 23, Belgium 13. Estimates for Italy place

the output for 1927 at 60 million pounds. In Germany very great increases are expected; no figures are given for the estimated English output but it is stated that Great Britain has a larger share in the world's rayon output than appears on the surface. —F.G.P.

Weavers: Selection. W. Mevius. *Melliand's Textilberichte*, 1925, **6**, 513-516, 601-604, 681-684, 757-764, 841-850, 929-938.

An investigation has been made of the individual efficiency of a number of weavers and the results are considered in conjunction with the age, home life, disposition, physique, and appearance of the operatives. Details of the tests are given for six men, three women, and three youths. The constitution of the "psychophysical" nerve system appears to control suitability or incapability in weavers. A test scheme for the selection of young weavers is described comprising medical examination, a short period of practical observation and instruction in the weaving shed, and a one-day ability test on test looms. —B.C I.R.A.

Viscose Silk Spinners: Health Hazards. —. Wauer. *Melliand's Textilber.*, 1926, **7**, 113, 489-490, 569-570, 650.

A general discussion of accident possibilities due to carbon disulphide ignition, the symptoms of carbon disulphide and hydrogen sulphide poisoning, and precautions necessary in viscose factories to protect the workers from these dangers. Viscose spinners are particularly liable to affection of the eyes by the acid used in the spinning bath; the susceptibility of workers varies and the affection generally lasts only 1-2 days. —B.C.I.R.A.

10—MISCELLANEOUS

Rayon and What can be Done with it. *Amer. Silk J.*, 1926, **45**, No. 2, p. 49.

A beginning is made towards educating the public by giving some facts, said to be little known—Rayon will give equal wearing service to other textiles if properly treated; it will not lose its lustre or turn yellow; it does not depend on climatic conditions for its existence; rayon fabrics may be made as fresh as new by ironing under a damp cloth; it is cool in summer and warm in winter; it is stronger than wool; it is not affected by the hottest and coldest water, and will withstand strong soaps better than silk or wool; rayon garments may be cleaned with petrol, &c.; rayon-cotton goods launder like all cotton; it is generally fast dyed and will stand starching without change of colour. —F.G.P.

Coventry Dyers' Company. *Dyer and Calico Printer*, 1926, **56**, xxv.

Some interesting facts dealing with the art of dyeing as practised around Coventry about the 16th century. An Act passed in 1532 indicates that the introduction of Brazilwood was made illegal. The proverbial expression "true as Coventry blue" arose from high quality blue thread dyed around Coventry in the 16th century. —A.J.H.

Cottonseed Oil: Manufacture. C. E. Rose. *Mech. Eng.*, 1926, **48**, 740-742.

Some data are given of the steam plant and power equipment of the Dixie Cotton Oil Co.'s mill at Memphis. The mill is the largest in the world and crushes 400 tons of seed per day of 24 hours. The sequence of crushing processes is outlined. —B.C.I.R.A.

Centrifuge: Mathematics. P. Beckers. *Melliand's Textilber.*, 1926, **7**, 515-516.

The mathematical basis of the construction of centrifuges is discussed. —B.C.I.R.A.

Calico Printing: Historical. O. Gaumnitz. *Melliand's Textilber.*, 1925, **6**, 919-921.

An account of the life of Johann Heinrich Edler von Schüle (1720-1811), one of the founders of the European calico printing industry. Schüle's activities were centred in Augsburg where the art is said to have been introduced from Holland by Georg Neuhofer in 1698. —B.C.I.R.A.

Embroidery and Lace: Historical. P. Rudolph. *Melliand's Textilber.*, 1925, **6**, 897-901.

The first hand embroidery machine was constructed in 1829 by Joshua Heilmann at Mülhausen, but was capable of producing only coarse work. It was subsequently improved and is still used for the manufacture of good white embroidered materials, especially the better classes of washing fabrics. The bulk of embroideries and laces are now produced on the shuttle machine, the first model of which was built by a Swiss in 1883. To-day these machines are fully automatic. The year 1881 saw the development of "lace" as opposed to "embroideries," when open backgrounds such as tulle were used instead of solid cambric or similar ground fabrics. Later, the dissoluble background laces (Luftspitze or Aetzspitze) were introduced. Various types of machine-made laces are illustrated. Plauen is the centre of the German lace industry. —B.C.I.R.A.

Fibre Moisture Determination Bottle. J. Barritt and A. T. King. *J. Text. Ins,t.* 1926, **17**, T392.

Patents

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

253,995. S. Fowler and E. Edser. Purification of wool fat.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Keratin: The Principal Constituent of Wool. A. P. Sachs. *Text. Colorist*, 1926, **48**, 670-672.

A discussion of the chief physical and chemical properties of complex amino acids in relation to the protein keratin found in wool. Wool keratin has a constant sulphur content of 3·2%. —A.J.H.

Wool: Heat of Wetting, and Moisture Relations. J. J. Hedges. *Trans. Faraday Soc.*, 1926, **22**, 178-193.

The heat of wetting of wool conditioned to different degrees was determined. The experimental method of measuring the heat of wetting and the moisture content of the wool at different relative humidities is described. It is shown that the heats of absorption deduced from the heats of wetting are in fair agreement with those given by a form of the Kirchhoff equation. The experimental heat of absorption curve lies closer to the one calculated by Shorter from Schloesing's figures than the one obtained from those of Hartshorne. There is a discussion of current theories of the mechanism of absorption as applied to the wool fibre. —B.C.I.R.A.

Damage to Wool from Dust. *Wool Record*, 1926, **29**, 1717.

Crossbreds should be used in depasturing the paddock in preference to merino, to the wool of which dust adheres more readily than to crossbreds. The raising of dust should be avoided at shearing time, as it will penetrate to the skin and remain to form the tip of the staple. This absorbs the natural grease needed for the healthy growth of the fibre and also spoils the appearance of the wool. Dusty roads should not be used for droving. The watering of yards at intervals to keep down the dust is a sound and inexpensive practice. B.R.A.W. & W.I.

Literature of Keratin. J. Barritt. *J. Text. Inst.*, **17**, T111-T126.

The Cotted Fleece. J. A. Fraser Roberts. *J. Text. Inst.*, **17**, T171-T179.

Colour Inheritance in the Wensleydale Breed of Sheep. *J. Text. Inst.*, **17**, T180-T186.

Kemp. H. J. W. Bliss. *J. Text. Inst.*, **17**, T264-T267.

Kemp Fibres in the Merino. J. E. Duerden. *J. Text. Inst.*, **17**, T268-T273.

Kemp in the Fleece of the Welsh Mountain Sheep. J. A. Fraser Roberts. *J. Text. Inst.*, **17**, T274-T290.

Kemp Fibres in Fleeces of British Breeds of Sheep. Janet S. S. Blyth, *J. Text. Inst.*, **17**, T291-T295.

Some Characteristics of Mohair Kemp. H. R. Hirst and A. T. King. *J. Text. Inst.*, **17**, T296-T304.

Wool Fibre: Gel Structure. J. B. Speakman. *J. Text. Inst.*, 1926, **17**, T457-T471, T472-T481.

(C)—Vegetable

Pink Bollworm Control in Certain French Colonies. *Rev. Appl. Entomol.*, 1926, **14**, Ser. A, 404 (from *Agron. colon.*, 1926, No. 99, 142-143).

An Act dated 22nd February 1926 repeals previous ones in connection with the protection of cotton from pink bollworm in the French colonies. It forbids importation into or movement in all French colonies, except Madagascar, of any plant or part of such that may carry the pink bollworm (especially *Hibiscus* and *Bauhinia*) from Egypt, East Africa, Nigeria, Sierra Leone, Asia, Brazil, Mexico, Hawaii, the British Antilles, Madagascar, Louisiana, New Mexico, and countries where the importation of such plants is not under control. Importation is permitted from other countries with a certificate as to freedom from infestation in the country of origin. —B.C.I.R.A.

Cotton Plant Diseases in Burma; Occurrence of——. D. Rhind. *Rev. Appl. Mycol.*, 1926, **5**, 344 (from *Ann. Rept. of the Mycologist, Burma*, for the year ended 30th June 1925).

Wilt was the only cotton disease reported during the year, the Wagale variety being chiefly affected. A selection from Wagale, however, has been found more resistant to wilt than most Indian cottons. A species of *Fusarium* resembling *F. vasinfectum* has been isolated from diseased plants in several localities. —B.C.I.R.A.

Cotton Root Rot in Texas; Study of——. *Rev. Appl. Mycol.*, 1926, **5**, 405 (from *38th Ann. Rept. Texas Agric. Exp. Sta.*, 1925, pp. 32-34).

An extensive study has been made of cotton root rot (*Phymatotrichum omnivorum*). In central Texas the vine *Ipomoea trichocarpa* is stated to be by far the most important carrier. The cumulative effects of sulphur treatment (10,000 lb. per acre) reduced the

incidence of infection to a minimum, but were not beneficial to the cotton. Large numbers of spores of *P. omnivorum* were found in irrigation ditches a few days after irrigation. Successful germination was effected by removing the waxy sheath which normally prevents the spores from absorbing water. The development of the fungus was found to be completely inhibited by 0·20% of normal hydrochloric acid, 0·21% of normal sulphuric acid, or 5·50% of normal sodium hydroxide.

—B.C.I.R.A.

Cotton Boll Rot in the U.S.A.: Occurrence of——. M. Shapovalov. *Rev. Appl. Mycol.*, 1926, **5**, 425 (from *Phytopath.*, 1926, **16**, 75).

During the past few years a decay of cotton bolls, beginning as a soft, pinkish rot, and finally causing the desiccation of the boll, has been prevalent in the south-western states. Affected bolls become filled and covered on the outside with black masses of spores resembling those of smut. The casual organism is *Aspergillus niger*, which is sometimes associated with insect injuries. Successful inoculations have been made, under field and laboratory conditions (76 and 100% infection respectively), by the insertion of spores in scalpel stabs or needle pricks. —B.C.I.R.A.

Cotton Wilt Disease in the U.S.A.: Study of——. *Rev. Appl. Mycol.*, 1926, **5**, 425-426 (from *Phytopath.*, 1926, **16**, 76).

Isolations of *Fusarium vasinfectum* from several parts of the United States showed an appreciable difference in their pathogenicity for cotton, and appeared to be distinct strains. Inoculation with a monospore strain in the greenhouse in late summer, and in soil temperature tanks at 30° C., gave 50% infection under the latter condition and none under the former. Experiments in the tanks at 22·5° to 35° resulted in no infection at 25°, some at 27·5°, and the highest incidence at 32·5°, while a trace was observed at 35°.

—B.C.I.R.A.

Cotton Wilt Disease in India: Investigation. S. L. Ajrekar. *Rev. Appl. Mycol.*, 1926, **5**, 489 (from *J. Indian Bot. Soc.*, 1926, **5**, 1-8).

Inoculations of Indian cotton varieties with strains of *Fusarium* from Dharwar and Nagpur afford proof of the parasitic nature of these *Fusarium* strains.

—B.C.I.R.A.

Cotton Pests in Australia. G. F. Hill. *Rev. Appl. Entomol.*, 1926, **14**, 336 (from *Proc. Pan-Pacific Sci. Congress*, Australia, 1923, **1**, 406-408).

Eight insects which have come under the author's observation as pests of cotton in the Northern Territory are named. *Earias fabia*, *Earias huegeli*, and *Platyedra gossypiella* are the most destructive. Their distribution in other parts of Australia is discussed. —B.C.I.R.A.

Pink Bollworm Control in Mexico and Texas. *Rev. Appl. Entomol.*, 1926, **14**, 358-359 (from *U.S. Dept. Agric., Fed. Hortic. Bd., Service and Regulatory Announcements*, No. 85, October to December 1925, 84-89).

The situation in Texas in 1925 is discussed, with sketch maps showing the districts infected in 1920 and 1925. In eastern Texas the pest appears to have been eradicated, but there is a serious reappearance throughout the western areas, possibly due to the fact that the semi-arid non-cotton belt is becoming narrower. The damage due to *P. gossypiella* in Mexico for the crop year 1925 was greater than in any previous year. The estimated percentage of non-pickable crop in 1925 was 31·8 as compared with 7·18 in 1924. —B.C.I.R.A.

Cotton Pests in Argentina: Control. *Rev. Appl. Entomol.*, 1926, **14**, 360-361 (from *Argentina Minist. Agric.*, Circ. No. 601, 1926, pp. 1-24).

The agricultural pests common in the Argentine are listed according to the season of the year, with brief notes on their habits and control. Spring pests include *Aphis gossypii*; summer pests, *Dysdercus ruficollis;* and winter pests, *Platyedra gossypiella*. —B.C.I.R.A.

Cotton Cultivation in Spain. "*The Times*," *Spanish Number*, 10th August, 1926, p.14.

The commercial possibilities of unirrigated cotton in Spain are insignificant because land values in humid areas are so high and the population is so dense that a more intensive and a more valuable crop is essential. Nowhere in Spain is found the combination of irrigation water at reasonable cost, freedom from rains during critical periods in the life of the plant, sufficiently high temperature during the growing season and long enough periods free from low temperatures such as is necessary for the commercial production of Egyptian cotton. The future of medium staple culture under irrigation is the most promising, but the suitable area is restricted to a maximum of 85,000 hectares on the Guadalquivir where at Cordova and Seville a small amount of cotton is already grown. Seed from San Antonio, Texas, has yielded up to 400 lb. of lint per acre in the area. The prospects of short staple unirrigated cotton are uncertain, depending on the future level of prices. —B.C.I.R.A.

Cotton; Physiological Properties of, and their Relation to Bleaching and Dyeing. H. C. Roberts. *Text. Colorist*, 1926, **48**, 691-693.

The wax, pectins, natural colouring matters and tannins present in raw cotton are discussed. —A. J. H.

Cellulose, and Starch: Constitution. H. Pringsheim. *Z. Angew. Chem.*, 1926, **39**, 1188.

A summary of the author's views of the constitution of cellulose and starch.

—B.C.I.R.A.

Cellulose: Swelling and Mercerisation. J. K. Katz. *Z. Elektrochem.*, 1926, **32**, 269-274.

The author reviews recent work on the heat developed in the swelling and mercerisation of cellulose, and seeks to interpret the difference in the form of the heat of swelling curve of Barratt & Lewis, and the alkali absorption curve of Vieweg by the aid of recent results obtained by Röntgen spectrography. —B.C.I.R.A.

Cellulose Fibres: Swelling in Nitric Acid and Philanised Cotton: X-ray Structure. J. R. Katz and K. Hess. *Z. Physikal. Chem.*, 1926, **122**, 126-136.

Natural cellulose fibres, after sufficiently long swelling in nitric acid of specific gravity 1·415-1·420 and washing, show changes in the Röntgen spectrogram which are characteristic of a cellulose fibre mercerised with sodium hydroxide and which prove a lattice change in the micelles. Nitric acid of low concentration does not give these changes in the micelles; there is a limit in the effectiveness of nitric acid which lies at an approximate concentration of 61% (S.G. = 1·381). The effects produced exhibit end-points dependent on the acid concentration. A similar limit exists at about the same concentration for the swelling and mercerisation changes induced in the washed fibres. This parallelism is specially noteworthy. The so-called Knecht compound $C_6H_{10}O_5 \cdot HNO_3$ not only has a constant composition, but has also a Röntgen spectrum which differs from that of cellulose. Philanised cotton does not possess the Röntgen spectrum of mercerised cotton, but that of natural fibres; a mercerisation band is at most just indicated. —B.C.I.R.A.

(D)—Artificial

Artificial Silk Experimental Plant. A. G. Perl. *Text. World*, 1926, **70**, 2004-2005.

An illustrated description of the training department of Messrs. Oscar Kohorn & Co., where provision is made for training textile and chemical engineers in connection with the manufacture of artificial silk. —B.C.I.R.A.

Artificial Silk: Manufacture. *Text. World*, 1926, **70**, 2002-2003.

Domestic and international connections of the major artificial silk-producing concerns are traced. The European industry, apart from that in Great Britain and Italy, is to a large extent centred round the Vereinigte Glanzstoff Fabriken A.G. of Elberfeld, which has world-wide interests, though a second ring is apparently in course of formation round the Comptoir des Textiles Artificiels in France. The Courtauld, Enka, and Tubize companies are other factors of great importance. The types manufactured by the various firms rare ecorded. —B.C.I.R.A.

Artificial Silk: Moisture Regain. G. F. Goldthwaite. *Text. World*, 1926, **70**, 894-895.

Simple tests showing the effect of sudden humidity changes on the moisture regain and extensibility of 100 denier viscose artificial silk yarn are described. On doubling the relative humidity in 25 minutes the moisture content rose from 8·5% to 20% and the elongation from 17% to 22·5%. After reaching this point of about 90% relative humidity the change continued to a final regain of 26% after another 35 minutes, and to 26% elongation. During the first part of the experiment, changes of 3% in moisture content and from 1% to 2% in elongation were noted in 5 minutes. On suddenly reducing the humidity the reverse changes took place as rapidly as before. —B.C.I.R.A.

Spun Artificial Silk: Manufacture and Uses. J. W. Cox. *Text. World*, 1926, **69**, 3967-3971.

A survey of the methods of spinning rayon wastes, and of the uses, advantages and disadvantages of the spun yarn as a textile fibre. —B.C.I.R.A.

Artificial Silk: Physical Properties. W. Weltzien. *Z. Angew. Chem.*, 1926, **39**, 1205-1206.

A summary of the author's recent work on the swelling, mechanical, and dyeing properties of artificial silk. —B.C.I.R.A.

Guignet-Wood Cellulose: Preparation and Properties. C. G. Schwalbe and W. Lange. *Z. Angew. Chem.*, 1926, **39**, 606-608.

"Guignet-cellulose" was prepared by acting on one part of finely-shredded wood cellulose with seven parts of 62% sulphuric acid for 5 hours at room temperature. The product (in 95% yield), which is a white gelatinous mass, is 97% soluble in 10% alkali solution, its cellulose number is 0·41, copper number 8·16, and hydrolysis number 14·65. The corresponding data are given for standard cellulose, Guignet-cotton cellulose and wood cellulose, and the differences are discussed. The value of the copper number increases in the conversion of wood cellulose to Guignet-wood cellulose from 2·35 to 8·16. The copper number of reprecipitated Guignet-wood cellulose is much lower (2·63) suggesting that the purified substance is similar to or identical with Hess's Cellulose A. The Guignet-cellulose contains only 0·56% of pentosans, as compared with 5·2% for sulphite cellulose. This suggests a method for isolating wood cellulose free from pentosans by treatment with 62% sulphuric acid. The pentosan content of 0·56 is lowered to 0·23 if the precipitant is alcohol, but is raised to 0·92 if ether is employed. A method of isolating cellulose from pine wood by the Guignet reaction is described. —B.C.I.R.A.

Preparation of Cellulose Acetate Silk. Review of Patent Literature. C. E. Mullin. *Text. Colorist*, 1926, **48**, 739-742.

Patents referring to processes of manufacture are discussed. —A.J.H.

Viscose Artificial Silk Plant. *Text. Merc.*, 1926, **75**, 136-137.

The viscose spinning plant and electrical equipment of the Python Mill owned by British Visada Ltd. is described. —B.C.I.R.A.

French "Artificial Linen" Slumps. *Text. Merc.*, 1926, **75**, 201.

It is reported that the manufacturers of the "Neo-fil" cloth intend to give up its manufacture. This news comes as a surprise as, when the new product, "artificial linen," was put on the market in 1925, the manufacturers claimed that it possessed all the qualities and virtues of the genuine flax fibre. Notwithstanding the opposition the makers received from the Linen Manufacturers' Associations of France and the Comite Linier de France, there was some demand for the Neo-fil cloth, and a large French shirt manufacturing establishment adopted the new product exclusively. Factories had been erected in the eastern part of France. —L.I.R.A.

Artificial Horsehair: Properties. J. Dillenius. *Text. Merc.*, 1926, **75**, 585.

An artificial horsehair has been made from cotton by a process which is said to be simple and inexpensive. It is claimed to have a resilient elasticity similar to that of natural horsehair and to have the properties necessary for weaving into tyre fabric. It is very suitable for the manufacture of automobile upholstery fabrics. Skeins have been seen in the untreated and processed states, and some of them, soft with a half-lustre, are said to be suitable for embroidery purposes. —B.C.I.R.A.

"Seris" Artificial Silk: Properties. *Text. Merc.*, 1926, **75**, 585.

The product is made by La Soie de Chatillon and is claimed to be a good imitation of natural schappe silk. It can be mixed with natural schappe, cotton or wool. It is cut to the staple desired by the spinner. Seris consists of a group of fine filaments which, after being cut into the desired staple, can be carded and spun on regular carding and spinning machines now in use in the textile industry. It is manufactured in three sizes—No. 10, containing strands of 0·8 denier; No. 25, with strands of 2·5 denier; and No. 35, with strands of 3·5 denier. The filaments of No. 25 and No. 35 approximate in size to the hairs of ordinary cotton and combines well with cotton. The No. 35 can be used with wool in fine cloths. No. 10 rivals the fineness of natural schappe. The nature of the fibre is such that it offers frictional resistance to slipping, consequently its binding quality is excellent. —B.C.I.R.A.

Patents

Manufacture of Artificial Silk and the Like from Cellulose Derivatives. H. Dreyfus. U.S.P.1,566,384 (from *Text. Colorist*, 1926, **48**, 278).

Describes spinning of rayon fibres from a solution in a volatile solvent and one of higher boiling point, which is not a toxic chlorine derivative, whereby fine denier thread may be spun. —F.G.P.

Cuprammonium Cellulose Solutions: Electrolysis. Taylor Laboratories, Inc. U.S.P. 1,590,592-3, 1,590,594, 1,590,596, 1,590,600, 1,590,601, 1,590,606, 1,590,607 (from *Brit. Chem. Abs.*, 1926, B818-819).

A series of patents relating to the formation of cellulose products with an unorganised structure, of rods, tubes, filaments, &c., of sheets of cellulose, of very finely divided cellulose, and of cellulose films from old rags, &c., by electrolysis of a cuprammonium solution of cellulose; alternatively, for the production of rods, tubes, and filaments, a zinc chloride solution of cellulose may be used. The apparatus necessary for the production of these different forms is described. A further patent describes the separation of silk and cotton by treating with an ammoniacal nickel solution, separating the cotton by filtration and recovering the silk by electrolysis of the filtrate. Finally, non-hygroscopic material suitable for artificial leather is prepared from a film of cuprammonium cellulose solution which is picked up by a slowly rotating drum round which hot air travels in the same direction, is passed through dilute acid which increases its strength, and is passed thence to an electrolytic cell where the solvent constituents are abstracted. On leaving the cell the material is washed, treated with 30% glycerin and water, and dried. —B.C.I.R.A.

Viscose Spinning Bath: Composition. D. van der Want and M. P. A. Bouman. U.S.P.1,596,906 (from *Chem. Abs.*, 1926, **20**, 3353).

In precipitating a viscose solution, a spinning bath is used containing, in addition to the usual spinning bath constituents, at least one salt, for example, nickel sulphate, of a bivalent metal the atomic weight of which is between 57 and 60, and the sulphide of which is not precipitated in acid solution. This forms a product of good dyeing properties. —B.C.I.R.A.

Machine for Pulling and Binding Flax. M. Delouzillières. F.P.597,809.

This machine comprises a share with a mould-board which penetrates in the earth, pulls out the flax and carries it against a rotating conical drum with an inclined axle. The stems are held against the drum by flexible rods. The carrying away of the stems is secured by the teeth of the drum. The flax is afterwards brought by an

elevator with an endless lattice up to a bundling apparatus. The projection of the teeth from the drum varies during the rotation, their shaft being eccentric with that of the drum. —Bur. Text.

Cellulose: Isolation. Chemische Fabrik Griesheim Elektron and H. Wenzl, Frankfort-on-Main, Germany. E.P. 256,757.
In the preparation of cellulose from wood, straws, or other fibrous vegetable material, the acid sulphite and bisulphite lyes of the alkali metals, preferably sodium, are used. The acid character and effectiveness of the lye may be modified by the addition of neutral sodium sulphite or sodium chloride, or by partly neutralising the lye with lime or calcium carbonate, or by the use of combined sodium and calcium bisulphite lye. The material may be boiled with the lye or saturated therein and the excess lye removed and the mass then heated to 100° for one or several hours. The mass so obtained is subjected to the action of chlorine, either in gaseous form or in solution, to produce a pure cellulose. Washing before chlorination may be omitted, the lye remaining in the mass being used up to neutralise the hydrochloric acid produced during the chlorination.—B.C.I.R.A.

Production of Vegetable Fibres—
256,570. Soc. Anon. A.L.F.A. Applicazioni Lavorazioni Fibra Alfa E. Affini. Process for obtaining fibres from esparto grass, alfa, and similar fibres.

Production of Artificial Fibres—
256,094. S. G. S. Dicker. Process for reducing solid substances and preparing colloidal solutions.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Raw Cotton: Oiling. *Nat. Assoc. Cotton Mfrs.*, Bull. No. 72, 1926.
The following results were obtained in a series of experiments in which oiled and untreated dyed cotton were run simultaneously on adjacent machines. There was no visible change in running quality in the pickers, and the percentage of waste removed by the beaters was substantially unchanged. There appeared to be slightly less fly round the cards running on oiled cotton, but the difference in actual waste was negligible. There was an improvement in the running of the oiled cotton in the drawing, roving, and spinning processes. In roving and spinning, the end breakage was appreciably lower, and in the slubber roving the amount of waste was less. No marked difference in the amount of fly was detected. Under the conditions of the test the average yarn strength of the oiled cotton was less than for the regular cotton. Further tests indicated that the effects of oiling were most evident in carding, spinning, and in the yarn itself. In carding, the invisible loss was much less, and in spinning the number of ends down was less, and the variation in breaking load of the individual samples was reduced. The breaking load was consistently lower and the yarn showed more variation in count in the individual samples. —B.C.I.R.A.

Cotton: Oil Spraying. *Times Tr. & Eng. Supp.*, 1926, **17**, 464.
The results of oiling cotton are explained, and the method of applying the oil is described. —B.C.I.R.A.

Drawing Frame; A New Slide——. T. Woodhouse and A. Brand. *Text. Rec.*, 1926, **44**, No. 521, pp. 47-48.
Various types of drawing and roving frames are described, and while those having double-threaded screws are suitable for flax and hemp, it is stated that this type is not satisfactory for jute. The machine most generally used is of the push-bar type, one of the most satisfactory being a new slide push-bar frame. This is described in detail, and attention is paid to the path of the fallers, which give a clean entry of the pins. —L.I.R.A.

Scutcher Fan: Control. H. Eigenbertz. *Text, Mfr.*, 1926, **52**, 219-220.
The optimum conditions for the fan draught in scutching machines are discussed. —B.C.I.R.A.

Card Cylinder Undercasing. H. Eigenbertz. *Text. Mfr.*, 1926, **52**, 338-339.
The author describes the function, construction, and method of setting the casing or under grid of revolving flat card cylinders. —B.C.I.R.A.

Oleine: Properties and Application. —. Kehren and M. Vater. *Melliand's Textilber.*, 1926, **7**, 857-858.
The composition of oleine, its manufacture, testing, possibilities of spontaneous ignition, and uses in the textile industry in the oiling of wool are discussed. Details are given of the Mackey apparatus for determining the liability of oleine to fire. —B.C.I.R.A.

Clothing for Woollen Cards. —. Brompton, *Text. World*, 1926, **69**, 3165.
The essential properties of card clothing are strength, firmness, and elasticity. Leather is the best foundation, but owing to its high price, cloth foundations have been used, where a number of woven fabrics are stitched or cemented together. Attempts are made to secure strength warp-way, and little elasticity length-way. Cloth foundations faced with vulcanised rubber are largely used. Wire used in card clothing needs to be worked to a fine, smooth surface. For woollen cards the wire used is bright or blued steel, and for worsted tinned wire is often used. Some carding machines are covered throughout with fillet, while others have cover cylinders, fancies, and inside doffers with sheet clothing, and here about 10% of the carding surface of the cylinder is without wire. —B.R.A.W. & W.I.

Variations in Woollen Roping. Tranl. from German by H. R. Mauersberger. *Text. World*, 1926, **70**, 197.

Experimental results show the effect of grinding and stripping woollen cards having various wires, wools, and emulsions and roping weights. The more emulsion used, the less is the variation in the roping after stripping, and the finer the grade of wool processed, the less is the variation in the roping after stripping. The heavier a roping is made, the less is the variation in the roping after stripping. An adjustment at the scale of the automatic feed on beginning a quantity would seem advisable. This might be readjusted after 20-30 minutes to the usual position. It is not wise to strip all three cards in a set at one time, as the variations in the roping will be too great. B.R.A.W. & W.I.

Bale Breakers, Openers, and Mixers. R. S. Curley. *Text. World*, 1926, **70**, 896-899.

Recent developments in the design of opening and mixing machinery are described, and the system which, in the author's opinion, is the best for handling low-grade cotton is summarised as follows—The bale breaker and tandem opening feeder gently open the cotton by a process approximating to combing action. The lattice opener and cleaner picks it from rolls, passes it over a great area of effective grid surface, and besides opening it further, cleans the heavy impurities from it. The vertical opener receiving it in small tufts, removes a class of droppings peculiar to itself. The horizontal cleaner is especially efficient in the removal of all possible pepper leaf and chaff. A thorough mixing is obtained by the use of the automatic conveyor and the mixing feeders with the feed table. The automatic distributor carries the stock directly to the hoppers of the breaker lappers. The electric feed controls so conjoin the various elements that a completely automatic opening system results, which is operated entirely by the feeding from the bales to the bale breaker and the doffing of the laps at the calenders of the breakers. —B.C.I.R.A.

Whitin Model D-3 Comber. Whitin Machine Works. *Text. World*, 1926, **70**, 2285.

A cotton comb constructed on a new principle is described. Due to a double link support of the nipper, the path of the tuft is always concentric to the periphery of the half-lap at the time the needles are passing through it. In addition, the nipper stops its backward motion slightly behind the centre line of the cylinder shaft—the best combing position—thereby allowing all the fine needles to pass through the stationary tuft of cotton, giving the cotton an extra fine combing, and imparting to it more lustre and sheen. By reason of the concentric path of the nipper, the full depth of the needles from the first row of large ones to the last row of small ones passes through the tuft of cotton to be combed. The nipper motion ensures also that the cotton at the time of detaching is presented at the proper position for the best possible piecing. A new coiler has been designed by which the amount of cotton in the sliver can may be regulated accurately. The estimated production is 22 lb. an hour for cotton of $1\frac{1}{16}$ to $1\frac{1}{8}$ in. staple. —B.C.I.R.A.

Rancidity and Oxidation of Fatty Oils in Regard to Wool Lubrication. W. Rhys-Davies. *J. Text. Inst.*, **17**, T220-T232.

(B)—Spinning and Doubling

Ring Springs. *Times Tr. and Eng. Supp.*, 1926, **18**, 515.

A new type of spring consists of a series of outer and inner steel rings. The inner sides of the outer rings and the outer sides of the inner rings are conical in shape and thus fit together in such a way that in an unloaded state the outer rings are a small distance apart; they are held at this distance by the inner rings, which are at a similar distance from one another. When the spring is loaded all the distances are reduced, and under full load the inner as well as the outer rings lie close to one another, being forced together by their conical sides. The outer rings are then under tension and the inner ones under compression, and all the material of the rings partakes in these stresses. Because of friction between the conical sides of the rings, the springs may be so constructed that the releasing power is only about 25% of the loading power. —B.C.I.R.A

Spinning Mule Quadrant: Action. *Text. Rec.*, 1926, **44**, No. 519, 45-46.

An explanation of the action of the quadrant in mule winding. —B.C.I.R.A.

Spinning Mule Counts Control Mechanism: Adjusting. F. Metcalfe. *Text. Rec.*, 1926, **44**, No. 521, 43, &c.

The article describes the adjustments necessary in spinning mule mechanisms when making radical changes in the counts to be spun. Directions are given for the adjustment of the mechanism controlling the rotary movement of the shaper or cop-builder wheel, for weighting the salmon-head lever, for changing the draft pinion, and for adjusting the back-shaft scrolls and setting the amount of "jacking."
—B.C.I.R.A.

Spinning Mule Twisting Motions. H. Mather. *Text. Mfr.*, 1926, **52**, 188-190.

A general account of the twisting motions applied by various loom makers.
—B.C.I.R.A.

Spinning Mule Copping Mechanism Trail-Lever: Effect of Change of Length. R. Fletcher. *Text. Mfr.*, 1926, **52**, 255-256.

The effects of altering the length of the trail-lever by moving the trail bowl in the copping mechanism of Platt's mules are discussed, and it is shown that there is

a certain position of the trail-bowl which is correct for any given set of conditions, and when the position is found all other mules under similar conditions should be set to it. Where new mules are being installed it is advisable to obtain from the machine maker a definite statement as to its exact position. —B.C.I.R.A.

Ring Frame Copping Mechanism: Control. *Text. Mfr.*, 1926, **52**, 293-294.

The conditions for obtaining good copping on ring frames are discussed.—B.C.I.R.A.

Spindle Tension Device. H. & B. American Machine Co. *Text. World*, 1926, **70**, 769.

The device is for band-driven spinning and doubling frames. The spindle whorl is of V-groove shape, which prevents slippage and causes the band to tend to work to the smallest diameter of the whorl. A uniform tension is maintained by a swinging carrier pulley running on an oilless wood bearing, and supported by a lever which is hung from the spindle rail. One band drives four spindles and there is no slip of the band on the cylinder as, for a four-spindle drive, it passes three times round the cylinder. —B.C.I.R.A.

Latsch High Draft Mechanism. O. Latsch. *Text. World*, 1926, **70**, 1155.

The top middle roller is positively driven from the bottom middle roller Both middle rollers are smooth and of smaller diameter than the front rollers. The weight of the middle top roller is adjustable to permit such slippage as may be necessary to prevent rupture of the fibre. The positive drive prevents the stoppage and breakage of uneven rovings or of rovings containing impurities which will not pass between frictionally-driven rollers. The front and middle rollers are spaced apart at a distance equal to about the average length of the fibre. —B.C.I.R.A.

Staple Fibre: Application. W. H. Canning. *Text. World*, 1926, **70**, 2001.

The uses to which "staple fibre" is being put to in England are outlined. In the cotton section it is spun alone or with as much as 50% of cotton, in counts from the coarsest to 2/120's. Above 60's it is usually used in 2-ply, either gassed and doubled or plain. —B.C.I.R.A.

"Snapped" Cotton: Spinning Tests. *Text. World*, 1926, **70**, 2236.

American official tests indicate that the spinning quality of "snap" cotton does not differ materially from that of "picked" cotton, but that "snapping" as a method of harvesting lowers the grade, the difference amounting to about two grades. The decreased cost of harvesting by the "snap" method may be much more than offset by the extra expense of passing cotton through boll extractors and by the loss of value resulting from the lower grade. —B.C.I.R.A.

High Draft Systems. F. B. Ricketson, F. P. Sheldon, E. E. Blake, E. Kent Smith. *Text. World*, 1926, **70**, 2277 (*b*) (124*c*).

An account is given of some experimental results obtained with different high draft systems applied to spinning frames, draw frames and fly frames, carried out under American mill conditions. —B.C.I.R A.

Ferrand High Draft Mechanism. *Text. Merc.*, 1926, **75**, 70.

The yarn is spun direct from the slubbing bobbin. Both mule and ring frames can be readily adapted to the system, bridge pieces being employed on the ring frame to connect roller beam with roller beam. The bridge pieces, which are of cast-iron, support three pairs of rollers arranged vertically. The top rollers are of heavy construction and the lower rollers are fluted, continuous in length and positively driven. A suitable roving traverse guide is provided. The drafting in the usual ring frame rollers is standard and the intermediate, roving, and spinning drafts are obtained by compound gearing. The slubbing bobbin is placed in the creel, the slubbing passing downwards through the rollers in close contact with them for approximately ½ of their circumference. The distance between the point at which the cotton leaves the first pair of rollers and that at which it touches the second pair is greater that the staple length of the cotton. During the passage through the apparatus a constant slippage is taking place and, further, the quarter turn in the slubbing is taken out before it reaches the back line of rollers of the ordinary ring frame. In passing into the nip of these rollers it can be observed that the fibres are quite parallel. In addition to cotton, wool, and asbestos, the apparatus will deal efficiently with cotton and wool mixtures. —B.C.I.R.A.

(C)—Subsequent Processes

Artificial Silk Bobbin Winder. J. Stubbs Ltd. *Text. Merc.*, 1926, **75**, 199.

A splicer bobbin winder for artificial silk is described. Each winding head is self-contained, the spindles being separately driven with the traverse motion working in an oil-tight box, thus preventing the oil splashing on the yarn. Stretching and breaking of the yarn is avoided by the friction coming into operation gradually when starting a spindle. The spindle is in a horizontal position; it is constructed in two parts, the blade portions of which may be made to suit any size of wooded bobbin. The yarn guide embraces a progressive wheel which revolves on a stationary screw and determines the diameter of the bobbin. The creel is overhead, and a compensating wire arrangement ensures perfectly even tension on the yarn during winding. —B.C.I.R.A.

(D)—YARNS AND CORDS

Immunised Yarn: Properties. G. Tagliani. *Melliand's Textilber.*, 1926, **7**, 765-770.

A general account, with photomicrographs, of the immunisation of yarns by treatment with para-toluenesulphonyl chloride, and of the properties and application of immunised yarns. —B.C.I.R.A.

Degree of Irregularity in 2-Ply Woollen Yarns. H. M. Williams. *J. Text. Inst.*, **16**, T311-T314.

PATENTS

Treatment of Silk Shreds. V. Piana. U.S.P.1,565,196 (from *Text. Colorist*, 1926, **48**, 203).

Silk crop waste is heated in a closed chamber until the adherent vegetable matter is dry and friable. It is then crushed and separated. —F.G.P.

Kapok Carding. Soc. Textile et Filature. F.P.597,889.

This machine comprises a perforated cylinder, combined with brushers provided with clothing, maintaining the lap of fibres in contact with the cylinder; carrying rollers bringing the lap up to the periphery of the cylinder, and clearers separating the lap from the cylinder. The dust and impurities are aspirated at the interior of the cylinder and evacuated through a passage into the axle of the cylinder. —Bur. Text.

Automatic Charging of Winding Frames. J. Mouret. F.P.598,336.

The winding frame comprises a support on which the axles receiving the bobbins are disposed so as to converge towards a certain point. This allows of unwinding of the yarn off the bobbin continuously without the use of a brake. —Bur. Text.

Sliver Can Rim Mount. J. A. and J. H. A. Sutcliffe, Belmont, Crumpsall, Manchester. E.P.252,932.

A metal mount adapted to be readily applied to and frictionally held upon the mouth of a sliver or like can is formed of substantially U-section, the outer fold having a series of indentations adapted to grip the wall of the can, the free edges of the mount being inwardly curled into beads. The mount is formed by dishing and forming a channelled edge on a metal plate, cutting out the centre portion, beading the edges of the annulus so formed, and producing the indentations for example by means of radially movable screw clamps, the ring being supported on a suitable holder. —B.C.I.R.A.

Spinning Frame Driving Mechanism. A. and J. Stell, Keighley, Yorks. E.P.255,986.

In electrically-driven spinning, doubling, twisting, and like machines, the driving motor is supported on a framework secured to the top of the end-frame of the machine so as to enable a long driving belt to be used, the framework serving also as a belt guard. The motor is pivotally mounted on a bracket secured to the framework and is supported by a spring mounted on an eye-bolt between adjustable check-nuts and a member which engages an extension of the casing. —B.C.I.R.A.

Winding Machine Thread Guide: Description. W. Prince-Smith and D. Waterhouse, Keighley. E.P.256,462.

A thread-guide for a yarn winding or like machine comprises a tubular metal body embracing a coaxial cylindrical pot guide, slotted and retained therein by the pressure of a spring in a notch. The top of the body is provided with a shaped slotted guide-plate having a flared entrance, and is secured to the traversing wires by a plate and screw. —B.C.I.R.A.

Yarn Clearing Mechanism. E. C. R. Marks, London (for Barber-Colman Co.). E.P. 256,492.

Clearing-apparatus for yarn, particularly for use in a winding machine, comprises a blade provided with relatively broad serrations, so as to minimise the collection of lint and fibre and to break any peripheral loops on the yarn; and adjustably mounted relatively to the yarn. In the arrangement shown, two serrated blades are mounted on parallel shafts and the yarn is guided between them by the edges of superposed plates and by pins against which the yarn is lightly held by detector fingers. The blades are pressed towards each other by leaf springs acting on arms fixed to the shafts, and the distance between them is adjusted by a pin which is mounted to pivot in its support and is held in its adjusted position by a screw and spring. —B.C.I.R.A.

Opener Feeding Mechanism. Platt Bros. and Co. Ltd., H. Wilkinson, and G. A. Bassett, Oldham. E.P.256,692.

Pneumatic apparatus for conveying fibres from a bale breaker, &c., to stack mixings in which a series of condensers is connected by a series of pipes and arranged so that any individual condenser may be cut out of action and the fibre passed by it, comprises a number of condensers connected by side pipes to a main pipe of uniform diameter. Double control valves are provided in the pipes to close the side pipe and open the way through the main pipe, so cutting out the condenser completely, or to open the side pipe and close the main pipe and so put the condenser in action. The valves are operated by a bell crank lever operated by a lever through a rod, or by suitable hanging chains. The condensers are driven by pulleys, and each is provided with a stripping roller with flexible flaps which will seal the outlet to the mixing bin when the condenser is not in action. The final condenser may be connected directly to the main pipe, the valves being omitted, so that the air is exhausted through the condenser and the fibres collected thereon and

prevented from travelling to the fan where none of the earlier condensers are operating. A number of rods, plates, &c., may as an alternative be placed across the main pipe intermediate, the valves of the last condenser to collect the fibres. —B.C.I.R.A.

Comber Waste Collector. J. L. Rushton and W. Hartley, Bolton. E.P.256,710.

In an arrangement of the Roth type for collecting the waste from a combing machine, the fluff-laden air which has been passed through the usual perforated cylinder is passed through an auxiliary waste-collecting device. This may comprise a fabric bag placed in the air trunk, which is provided with two separated flanges against which the circular rim of the bag rests. Holes are provided in the trunk through which the bag can be placed in position. These holes are provided with a sliding sleeve having corresponding windows. —B.C.I.R.A.

Non-slipping Cop Tube. G. H. Green, T. Kilbourn, and Economic Windings Co. Ltd., Leicester. E.P.256,740.

Bobbins, cop tubes, &c., are fitted, indented or provided with protruberances on their surfaces to prevent the slipping of the windings thereon. The irregularities may be formed by moulding or otherwise preparing a sheet material which may be secured on the cop by glue or other adhesive. —B.C.I.R.A.

Winding Machine Stop-motion. X. Brügger, Horgen, Switzerland. E.P.256,782.

In a bobbin winding machine each of the bobbins is rotated by being clutched between a friction cone on the end of a driving shaft and a conically-ended trunnion resiliently mounted on the machine frame. The bobbin is normally pressed against the friction cone by a spring, but when owing to the irregularity in the feed, the thread is drawn over a feeler, a control lever is caused to be swung over so that it relieves the tension in the spring and enables a second spring in the driving shaft to press the bobbin out of engagement. —B.C.I.R.A.

Card Coiler Box Lid Locking Device. A. Ashton, Failsworth, Manchester. E.P. 256,844.

A catch-plate locking device for the lid of a carding engine coiler box is described. —B.C.I.R.A.

Spinning Frame Electric Drive. L. Mellersh-Jackson, London (for Siemens Schuckertwerke Ges.). E.P.256,887.

Motion is transmitted from an electric motor through a coupling and a pinion to the gear wheel on the main shaft. The pinion is keyed to the near coupling, half which is mounted to rotate on an overhanging shaft secured in the casing wall. In a modification, teeth on the coupling half constitute the pinion, and the coupling half is secured to a shaft which rotates in a bearing on the casing wall.—B.C.I.R.A.

Ring Frame Spindle Apparatus. G. Bettini, New York. E.P.256,914.

Spindle apparatus for twisting and winding yarns comprises a driven frame comprising vertical arms secured to a wharl, a guide secured to a top ring of the frame, a reciprocating guide which slides on the frame arms, and a tube holder which is mounted on a non-driven spindle and is retarded by wings at the base. The fixed guide is so shaped as to impose restraint upon the yarn and thereby to confine the twist to the yarn extending therefrom to the supply point. The reciprocating guide may be a simple eye to impose a light tension on the yarn, and is mounted on a sliding carriage which is shaped to engage the frame arms when they are square or is splined thereto when they are round, and is provided with fingers to straddle a reciprocating plate or bar. The tube holder comprises a conical sleeve and a base carrying the wings to impart the necessary drag. The tube lightly embraces the spindle which is integral with or secured to a post secured in a socket. The wharl is provided with a depending sleeve, and bearing rings are interposed between it and the socket which is shaped to form an oil well provided with lubricating ducts and is protected by a cap on the wharl. —B.C.I.R.A.

Artificial Silk Spinning Rotary Pump. British Enka Artificial Silk Co., London. E.P.256,917.

In a pump with outwardly sliding vanes as described and claimed in Specification 28974/25 for making artificial silk, the intermediate plate is movable relatively to the piston and the abutment. —B.C.I.R.A.

Spindle Driving Mechanism. Brooks and Doxey Ltd. and J. Greenhalgh, West Gorton, Manchester. E.P.257,070.

In spinning, doubling, and like machines, the tension pulleys of the spindle driving bands are simultaneously moved about pivots on brackets secured to levers and the shaft on which the levers are mounted is moved longitudinally so that the tension pulleys may be readily arranged for spinning twist or weft. The lever shaft is actuated by the engagement of arms on levers carrying the tension pulleys by arms on a rod moving horizontally. —B.C.I.R.A.

Mule Spindle Oil-splash Prevention Device. Platt Bros. & Co. Ltd., F. Radcliffe, and B. J. Holt, Oldham. E.P.257,075.

Splashing of oil from the bolster bearings of mule or twiner spindles is prevented by a shield mounted upon the upper spindle rail and extending in front of the spindles or suspended from the faller shaft. The shield, which may be made of felt or other absorbent material, is secured either to the wooden rib in the rabbet or to the front

of the upper spindle rail. The shield may comprise a rail hinged to the wooden rib and held in position by turn buttons. The rail carries a projection extending towards the spindles, and the felt strip is secured in the angle. The shield may be hung by wire loops from the faller shaft. In all cases the shield may be in one continuous length or in sections, and is readily movable from its ordinary position to allow access to the spindles. —B.C.I.R.A.

Yarn Dope Impregnating Apparatus. J. G. A. Rhodin, Draycott, Derbyshire, and E. B. Westman Ltd., London. E.P. 257,097.

Cotton yarns are impregnated with solutions of cellulose or its derivatives to produce a washable finish with simultaneous mercerisation of the cotton by apparatus comprising a "doping" tank, one or more dies or grooved rollers, drying tube or chamber through which a counter current of air is passed, and a traverse mechanism for the winding bobbin, this mechanism comprising a thread carrier mounted on a parallelogram frame raised and lowered by a cord passing over a pulley and connected to a stud on a wheel. The tank is provided with rollers immersed in the dope and the inlet and outlet dies are of sapphire or equivalent secured by clips. Split dies may be used in a holder comprising a split metal tube grooved to receive the discs holding the dies. —B.C.I.R.A.

Drawing Roller Clearer Flat. Fine Cotton Spinners' & Doublers' Association Ltd. and J. T. Bunting, Manchester. E.P. 257,101.

The flat comprises a thin flat plate recessed at two edges and adapted to retain a tubular cover without adhesive. The plate is provided with trunnions and is formed of light material not liable to warp with heat or moisture, e.g., aluminium, vulcanised fibre, vulcanite or celluloid. Well-seasoned hard wood may also be used, but vulcanised fibre is the preferred material. The cover is of flannel or other woven material, and is preferably woven tubular. —B.C.I.R.A.

Drawing Roller Head Reciprocating Clearer Motion. Fine Cotton Spinners' and Doublers' Association Ltd. and J. T. Bunting, Manchester. E.P.257,102.

The motion comprises a bent rocking lever weighted and supporting a cross-bar which carries the clearer-flats. The lever is fulcrummed on a knife-edge or point which enters a notch in a reciprocating bar placed below the rollers and at right-angles to their longitudinal axes. The flats, which are self-aligning in all directions, are preferably of the construction described in Specification 257,101. —B.C.I.R.A.

Artificial Silk Cop Shields. J. R. Stell, Keighley. E.P.257,118.

Shields for the tapering ends of spools, bobbins, pirns or the like, especially for use with yarn of springy material such as cellulose acetate, or artificial silk, are formed with a turned-over corner to facilitate ready detachment. Paper may be used and the end secured by adhesive, or sheet metal, such as aluminium or sheet celluloid may be used, the lower edge in these cases being slightly splayed to avoid damage to the cop when being applied thereto. —B.C.I.R.A.

Spinning Spindle Apparatus. T. A. & H. A. Boyd, and J. & T. Boyd Ltd., Glasgow. E.P.257,128.

In spinning and like frames in which spindles or tubes are driven and traversed relatively to the flyers to which they are not attached, for example as described in Specification 236,810, a disc driven by the spindle or tube is provided with pins adapted to engage by reason of centrifugal force the interior of a cup on the spindle socket or mounted on the lifter rail. The flyer drives the spindle or tube by means of a jointed arm. —B.C.I.R.A.

Roving Machines: Roving Guides. J. Wood and W. Haynes, Philadelphia, U.S.A. E.P.257,176.

In spinning and roving machines of the kind in which reciprocating guides are mounted immediately behind the front rollers, brackets are secured to standards to support guide rollers close to the drawing rollers, and are slotted to accommodate bars which carry roving guides and are connected with the rear traversing guide-bar by means of bars. —B.C.I.R.A.

Yarn Reel. X. Brügger, Horgen, Switzerland. E.P.257,210.

In yarn reels of adjustable diameter, the successive spokes are pivoted alternately on the inside and outside of the flanges in order to obtain a wider angle of movement for the spokes, and a corresponding greater variation in diameter of the reel. Guiding and holding plates have arms for adjusting the spokes, and a ring-shaped runner having a wavy ball-race facilitates adjustment. A nut clamps the plates and race together. —B.C.I.R.A.

Combing Machine Nipper Reciprocating Mechanism. Soc. Alsacienne de Constructions Mécaniques, Mulhouse, Haut Rhin, France. E.P.257,232.

In a combing machine of the Heilmann type in which the nippers are reciprocated between the combing position and the detaching position, means are provided to secure that the nipping point shall move in a path which shall be concentric with or tangential to the comb needles, and then rise in an arc to a point near the detaching rollers and be in the direction of movement of the lap. —B.C.I.R.A.

Carding Engine Grid. M. Wehli, Mulhouse, Haut Rhin, France. E.P.257,235.

A grid of the kind described is provided with a cleaning knife secured to the cross-piece. The cross-piece is pivoted on the

grid frame and is secured in its adjusted position by a screw engaging in a slot in a lug on the cross-piece. The knife is adjustably secured by screws to the front of the cross-piece and may be in one or several pieces. —B.C.I.R.A.

Carding Engine Licker in Grid. J. Schmitt, Haut Rhin, France. E.P.257,255.

The grid of the licker-in for a carding engine is provided with toothed bars mounted on pivots. The bars can be moved from their working position to a position for cleaning by a lever provided with a spring pawl. The lever can be operated by any suitable part of the carding engine. The bars are returned to their working positions by springs. —B.C.I.R.A.

Cotton Batting Winding Machine. M. J. Stack, New York, U.S.A. E.P.257,308.

Lengths of cotton batting are wound on a core mounted on a spindle supported in guides in brackets on a frame. The roll rests on rollers driven by chains. The batting is guided to the roll by a horn to a point closely adjacent to the roller. The horn is mounted on a sleeve sliding on a slotted cylindrical housing enclosing a double-threaded screw driven from one of the rollers. The hollow paper core is mounted on spacing plugs on the spindle. —B.C.I.R.A.

Winding Machine Driving Gear. J. D. Joyce, Philadelphia, Pa. E.P.257,315.

The drive shaft drives a countershaft which is journaled in a casing and which carries rockshafts. Full details are given. —B.C.I.R.A.

Cop-winding Apparatus. J. D. Joyce, Philadelphia. (1) E.P.257,497. (2) E.P.257,498.

Extensions to Specification 257,315 comprise descriptions of (1) the bunch building mechanism, (2) stop-motions for the said mechanism. —B.C.I.R.A.

Conical Bobbin. A. D. Muller, New Jersey, U.S.A. E.P.257,550.

A bobbin suitable for any type of spinning machine comprises a hollow frusto-conical body open at the bottom and threaded at the base to receive a disc which is interchangeable to suit the particular type of spinning machine with which the bobbin is to be used. The surface is knurled to prevent slipping of the yarn.—B.C.I.R.A.

Artificial Silk Winding Swifts. J. P. Bemberg Akt.-Ges., Barmen, Germany. E.P. 257,554.

The swift has two opposite cross bars radially movable in the frame formed by four fixed bars and the spiders, the movable cross-bars being connected by links to the shaft which is axially slidable in the frame. The swift is held in the extended position either by a member pivoted on the shaft which is moved out of contact with the spider when the swift is collapsed, or in an alternative way described. The swift is preferably made in acid-proof steel, and is stated to be specially suitable for use for winding cuprammonium artificial silk. —B.C.I.R.A.

Cop Tube Setting Device. J. B. Wade, Hollinwood, Oldham. E.P.257,755.

A device for setting cop tubes on spindles comprises a horizontal member mounted to slide on vertical rods and provided with fingers each provided with a nipple adapted to pass over the spindles and to engage and press the cop tubes home. The longer ends of the vertical rods are provided with conical recesses to engage the tops of spindles to position the device and the horizontal member is operated against the effect of springs arranged between shoulders of the vertical rods and plugs at the top of tubes adjustably secured to the member. Buffer springs are provided to cushion the return movement of the member when the device is removed from the spindles. The nipples are yieldingly mounted in the fingers and are of different diameters to fit different sets of spindles. —B.C.I.R.A.

Carding Engine Feed Mechanism. F. Bohle, Wesdau, Saxony, Germany. E.P.257,810.

In a carding engine feed the scutcher lap is arranged at the side of the weighing device and above a receptacle containing waste. The lap is unrolled by a lattice, and fed upwards between two lattices (one spiked) to an oscillating comb. The waste is fed upwards by a spiked lattice below the lap lattices and is transferred by a roller to the spiked lap lattice. The lap and the waste may be fed simultaneously and mixed, or each may be fed alone. The spiked lap lattice and the spiked waste lattice may be made in one. Two or more laps may be arranged one above the other so as to be fed successively or simultaneously. The lap may be of different qualities of cotton and the fibres mixed—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Preparatory Processes—

256,072. P. C. Rushen. Combing machines: arrangement for collecting and delivering waste, noil, &c.

256,621. C. D. and M. V. Leterine. Scutching apparatus.

256,639. C. Schleifer. Carding engines.

Spinning—

257,117. W. Prince-Smith. Spindle apparatus.

257,215. O. Lambert. Spindle rails: stop-apparatus; non-automatic.

Winding—

256,450. O. Lambert. Cop winding frame for jute, flax, or hemp yarn.

Yarns and Cords—

256,337. W. Matterson. Machine for covering elastic and other cores.

256,342. H. Hogg. Production of knapped yarns of different colour and character.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Beam Truck. J. T. Hardaker Ltd. *Text. Rec.*, 1926, **44**, No. 519, 97.

The truck enables beams to be transported and transferred to the loom by one man. It comprises a rigid platform on four supports and it runs on four wheels arranged at the mid-points of the four sides; two of the wheels have encased roller bearings and the other two are sliding. The beam and truck are wheeled into position behind the loom, then by means of a T-handle and patent raising mechanism the platform of the truck is raised to the desired height, one side of it is lowered and the beam is rolled into its position in the loom. —B.C.I.R.A.

Cop-winding Machines for Jute Yarns. J. F. Low & Co. Ltd. *Text. Mfr.*, 1926, **52**, 308-309.

A cop-winding machine for jute yarns made by J. F. Low & Co. is described. The special features and advantages claimed are—(1) Ease of access to all parts. (2) Simplicity of adjustment. (3) Low cost of renewal of wearing parts. (4) Variable speed drive. —L.I.R.A.

Celanese Silk: Winding and Weaving. R. V. Patchett. *Text. Rec.*, 1926, **44**, No. 522, 77-79.

Some points of practical importance in connection with the winding, warping, weaving, and finishing of Celanese are discussed. —B.C.I.R.A.

High-speed Beam Warping Machine. T. Holt Ltd. *Text. Mfr.*, 1926, **52**, 343.

A description is given of a high-speed beam warping machine attaining a speed equal to twice that hitherto obtained in ordinary beam warping. This speed is attained by—(1) Unwinding over the end of stationary cheeses so that no limit is here imposed on the rate of unwinding. (2) Modifications in the head stock. The more important advantages are—(1) Though the yarn speed is very great the beams are wound better than in ordinary beam warping. (2) The natural elasticity of the yarn is better preserved since varying and excessive tensions are eliminated. (3) Greatly increased production. —L.I.R.A.

Wooden Beam Heads: Application. Allen Co. *Text. World*, 1926, **70**, 769.

Wooden beam heads for high-speed warping machines withstand knocks, eliminate breakage and, on account of their extreme lightness, are easy to handle when doffing the machine. A loom beam head of both the stationary and the adjustable type has now been developed. —B.C.I.R.A.

Artificial Silk; Winding, Warping, and Sizing ——. R. Winder. *Text. World*, 1926, **70**, 2022-2023.

The adaptation of cotton machinery to deal with artificial silk is discussed and some details are given of the conversion of a spooler, a warper, and a slasher. In the spooler, the yarn boxes, bobbin-holders, thread guides and spool rack were removed and two cast-iron brackets to hold the swifts were attached one to the rail that supported the bobbin holders and the other to a rail placed where the spool rack had been. The end from the bottom swift had the thread guide rail for a guide. To this guide rail was also attached a small casting with a ½ in. round steel guide under which the end from the top swift was run. This also held the spool while the knot was tied. It was also necessary to change the cam to fit the small spool and slow down the speed. In the warper the drop wires were removed and the measuring roll raised so that a piece of black-painted Beaver board extending the length of the warper could be placed beneath to facilitate the detection of imperfections. The stop-motion was also removed. In the adapted slasher the yarn does not go down into the size box but passes between the size roll and squeeze roll, and the size box is placed close to the cylinder to prevent stretch. —B.C.I.R.A.

(B)—Sizing

Hand Sizing Machines. Director of Industries, Bombay Presidency. *Text. Rec.*, 1926, **44**, No. 519, p. 97.

Two sizing machines, one suitable for a small hand-loom factory and the other for the individual cottage weaver, have been designed. The factory machine requires a special wooden warping machine. The capacity of the two machines is indicated. —B.C.I.R.A.

Leico Gum: Application. A. Pflanzer. *Melliand's Textilber.*, 1926, **7**, 700.

Leico gum is a powder prepared from the kernels of carob beans and has hitherto been known in paste form as Tragasol. It possesses the property of penetrating the smallest pores and interstices of the thread, thus filling it and increasing its resistance and flexibility. The handle of the finished cloth is thereby improved. It is claimed that common weaving difficulties due to too light or too heavy sizing are avoided by the use of Leico gum, and as the product is neutral there is no possibility of damage to the fibre. It is easily removed in desizing, and in dyeing coloured warps it does not mask the most delicate shades. Its use permits 20-30% less potato flour to be used, and less fat. —B.C.I.R.A.

Haake's W-Starch: Application. B. Engelhardt. *Melliand's Textilber.*, 1926, **7**, 839-840.

The product has been submitted to tests at the Dresden Research Institute, and the following opinion is given—Haake's W-starch gives a paste which is nearly as thick as one containing an equal quantity of wheat starch. Its sizing effect is better than that of wheat starch and equivalent, both in coating power and penetration, to hydrolysed wheat starch. Of five yarns sized respectively with potato starch, hydrolysed potato starch, wheat starch, hydrolysed wheat starch, and Haake's W-starch, a practical sizing firm selected that sized with W-starch as the best. The product also promises well in finishing. In a trial in which wheat starch was replaced by an equivalent quantity of W-starch a better finish was obtained, whilst the cost is less than half that of wheat starch. —B.C.I.R.A.

Artificial Silk Warps: Sizing. *Melliand's Textilber.*, 1926, **7**, 878.

The purpose of sizing is not only to give increased strength but to cause the filaments to adhere to form a composite thread. The consensus of five opinions is that sizing is best carried out in hank form—only one mentions full width sizing—and that only a thin solution must be employed. A hydrolysed solution of potato starch is generally recommended, Aktivin, Stoko tablets, Degomma DL, and Diastafor L being used as hydrolysing agents. Rabic and Glykom are mentioned as sizing compounds for artificial silk. Rabic is said to penetrate the filaments readily and provide a smooth thread.—B.C.I.R.A.

Soluble Starch: Preparation. M. Ekhard. *J. Inst. Brewing*, 1926, **32**, 281 (from *Z. Spiritusind*, 1925, 17th Dec.).

Starch suspended in water to which 1% of Aktivin has been added, is converted in 10 minutes to soluble starch, the operation taking place more rapidly than with perborate. Soluble starch produced by this method contains traces of sulphamide and sodium chloride, whereas, when perborates are employed, the resulting product contains a little sodium borate which has certain advantages. The value of the soluble starches prepared by the perborate method is diminished owing to their acquiring a yellow colour. This disadvantage is shared by starches prepared by the use of Aktivin. —B.C.I.R.A.

Starches for Textile Finishing; Comparison of Maize and Potato——. W. Ekhard. *Brit. Chem. Absts. B.*, 1926, p. 706 (from *Z. Spiritusind*, 1926, **49**, pp. 196-7).

Potato starch contains much less fat and protein than maize starch and yields more viscous aqueous solutions. The viscosities of 5% solutions of potato, maize, and wheat starches are as 3·57: 1·17: 1·00; and a solution containing 150 g. of maize starch and 2,850 g. of water has nearly the same viscosity as a similar solution containing only 100 g. of potato starch to 2,900 g. of water. Aktivin attacks potato starch more rapidly than maize starch, and textile finishing pastes prepared by the action of Aktivin on potato starch are about one-half as viscous as similar pastes prepared from maize starch. Biolase and Diastafor, Degomma, and Novo Fermasol liquefy potato starch much less rapidly, equally, and slightly less rapidly respectively than maize starch. Potato starch has better binding properties when used in the weighting of textile materials. It is very difficult to prepare solutions of maize starch free from gelatinised "lumps," which are undesirable in finishing pastes. —L.I.R.A.

Artificial Silk: Sizing. P. Bean, Jr. *Text. Merc.*, 1926, **75**, 426.

A short general article. Thin boiling starches are recommended. The ordinary slashing machine is not suitable since it imposes too much tension and the thread picks up too much size when passed under rollers in the sow box. A modified machine is described. Spring balance indicators to impose tension at the back beam are recommended instead of weights. —B.C.I.R.A.

Isthmus XC Starch: Properties. Isthmus Size and Chemical Co. Ltd. *Text. Merc.*, 1926, **74**, 567.

Isthmus XC starch is a warp sizing product which may be used by itself or in conjunction with ordinary sizing materials. The product possesses greater strength and adhesiveness than the usual sizing ingredients and secures a more consistent and uniform percentage in light, medium, and heavy sizing. It is especially suitable for fine goods and coloured materials. —B.C.I.R.A.

Starch Films: Moisture Relations. E. Swan. *J. Text. Inst.*, 1926, **17**, T527-T536. —B.C.I.R.A.

Size, Deliquescent: Hygroscopicity. E. Swan. *J. Text. Inst.*, 1926, **17**, T517-T526.

Size, Deliquescent: Estimation. S. M. Neale. *J. Text. Inst.*, 1926, **17**, T511-T516.

Sizing Artificial Silk. See Section 3A.

(C)—WEAVING

Artificial Silk: Shuttle Tensioning Devices. *Text. Rec.*, 1926, **44**, No. 521, pp. 49 and 53.

The shuttle tensioning devices for use with artificial silk weft are discussed and include the fur lining, the spring and metal plate tension, the ring tension, and an American tension comprising twin steel pads guided by an encased spring which is controlled by an adjustable set screw for varying the pressure. —B.C.I.R.A.

Multiple Leaf Tappet. T. A. Brandwood. *Text. Mfr.*, 1926, **52**, 229-230.

The influence of the treadle-bowl diameter on the shape and functioning of the tappet is discussed. —B.C.I.R.A.

Dobby Lag Peg Extracting Machine. Jones Textilaties Ltd. *Text. Mfr.*, 1926, **52**, 233-234.

The machine punches the pegs out of used dobby lags at the rate of 30 lags per minute. It comprises essentially a rectangular frame in which is a slotted cylinder which forms a seat on which the lags rest momentarily while the pegs are struck out, a positively-driven downward striking punch bar, and means for guiding and gripping the lags during the process of punching out the pegs. A lag pegging machine built by the same firm is also described, but this has been available for a number of years. —B.C.I.R.A.

Interlaced Twill Fabrics: Weaving. *Text. Mfr.*, 1926, **52**, 329-330.

Point paper diagrams and directions for weaving crossed twill and interlaced designs used for mixture cloths and also for piece-dyed goods are given. The simpler designs repeat on 16 picks, but there is a wide scope for effective designs operating on 24 picks. —B.C.I.R.A.

Shuttleless Loom and Nicolet Loom. *Text. Rec.*, 1926, **44**, No. 521, p. 94.

Brief notes on new types of looms cover a shuttleless type in which yarn from big cross-wound cheeses is conveyed across the shed by grippers, and the new Nicolet loom in which there is simultaneous formation of a front and a back shed. Two picks are introduced into the front shed, and a third one into the back shed simultaneously. The reed then beats up the three picks at once. The loom is only suitable for warps with comparatively few ends per inch as lenos, bandage cloths, &c. —B.C.I.R.A.

Loose Reed Warp Protector: Action. J. Anderton. *Text. Mfr.*, 1926, **52**, 339.

The author describes what in his view happens when the shuttle is trapped in the shed, i.e., that the duckbill slides under the heater some ⅜ in. when in the full forward position. He shows the inaccuracy of the text-book statement that the duckbill slides over the heater and the consequent uselessness of the stop-motion mechanism based on this belief. —B.C.I.R.A.

Cotton Felt Loom. R. Hall & Sons (Bury) Ltd. *Text. Mfr.*, 1926, **52**, 342.

An improved type of cotton paper maker's felt loom, of 25-foot reed space and capable of speeds of 48 picks per minute is described. The loom is characterised by the high mechanical strength and rigidity required in all its parts. Notice is given also of the manufacture of different looms constructed up to 40 feet reed space for cotton and other cloths, and of the necessary winding, beaming, &c., machinery to be used in conjunction with them. —B.C.I.R.A.

Narrow Tulle Fabrics: Weaving. M. Böhmer. *Melliand's Textilber.*, 1926, **7**, 754-756.

Narrow-width tulle fabrics are made by weaving strips of the required width side by side—but held together by a connecting thread which is withdrawn when the fabric is taken from the machine. A selvedge thread as provided at each edge of the strip and the connecting threads are supplied by separate shuttles. The action of the double Locker machine on which the narrow tulles are woven is discussed. —B.C.I.R.A.

Dobby and Jacquard Griffes: Rate of Movement. J. Funke. *Melliand's Textilber.*, 1926, **7**, 828.

A common opinion that the griffe moves more slowly in double lift machines than in single-lift top and bottom shedding machines is controverted. —B.C.I.R.A.

Loom Harness Cords: Varnishing. A. Schulze. *Melliand's Textilber.*, 1926, **7**, 830-831.

Some notes on the efficient varnishing of harness cords and the general care of harness. —B.C.I.R.A.

Loom Harness Cords: Preparation. F. Müller. *Melliand's Textilber.*, 1926, **7**, 832-833.

In cords for harnesses, dobbies, and jacquards, the decisive factor in the wearing value of the material is the quality of the cord itself, not the method of preparation. An old harness which was not improved by treatment with linseed oil varnish was restored by adding other ingredients, chiefly melted cobbler's wax and Russian glue, to the varnish. Cobbler's wax is also recommended for treating those parts of cords which are subject to friction, such as the parts coming into contact with the cord board in jacquard weaving; its stickiness is overcome by a subsequent wax polish. The effect of cord structure is shown by some experiments in which unprepared cords containing three 2-fold yarns lasted hardly 14 days, whilst cords containing three 8-fold yarns lasted up to two months under the same conditions. Preparation with machine oil had no effect on the durability of the cords, but the cobbler's wax treatment increased the life of the cord made from 2-fold yarns by three or four times, and that from the 8-fold yarns up to ten times. —B.C.I.R.A.

Internal Selvages for Cutting. R. Hunlich. *Melliand's Textilber.*, 1926, **7**, 871.

In order to weave several webs side by side on wide looms it is necessary to provide internal selvedges that may be cut after weaving. The author describes a number of devices for producing such selvedges. —L.I.R.A.

Plain Loom Third Harness Mechanism. H. C. McKenna. *Text. World*, 1926, **70**, 199.

An arrangement for equipping a plain loom with a third harness to be operated independently by the box-motion is described. The connecting lever from the intermediate to the disc crank is removed and the intermediate is fastened to the box-motion by a brace. The disc crank is then used to operate the extra harness, the weave being built on the box chain. One or two shuttles may be operated in the usual manner, and any desired weave of the extra harness is possible as long as it is a multiple of 2; e.g., 6/2, 4/4, 2/4. The cost of installing the motion is very low. —B.C.I.R.A.

Regan Warp Stop Motion. Crompton and Knowles Loom Works. *Text. World*, 1926, **70**, 1465.

The oscillating rods are flattened on two opposite sides, and are free to turn to one side and then back into vertical position. When a warp thread breaks the wire drops and the constricted upper part of the head of the wire fits over the flattened sides of the oscillating rod and resists the normal motion sufficiently to actuate the knock-off which throws off the stripper. The loom is knocked off by the cam which drives the motion—hence the opportunity is afforded for stopping the loom where desired. The cam control of the motion and knock-off is such that the particular stopping position of the lay may be set to meet any given conditions. Below the warp and on each side of a row of drop wires are so-called frame bars or separator bars which resist the twist of the wire which is down, indicating instantly the location of the broken end. The drop wires have bevelled ends and the thread slot edges are rounded. —B.C.I.R.A.

Artificial Silk Narrow Fabrics: Weaving. M. E. Jameson. *Text. World*, 1926, **70**, 2019-2020.

Practical notes on spooling, warping, and weaving in the manufacture of narrow artificial silk fabrics such as ribbons. Friction and undue tension must be avoided and the control of humidity is important. A circular creel for narrow warps is shown, and a steel spring device such as can be applied by the mill mechanic to control tension in warping. —B.C.I.R.A.

Gawsworth Self-weaving Loom Attachment. O. Shimwell. *Text. Merc.*, 1926, **75**, 557.

The mechanism is arranged at both sides of the loom. The weft carrier is like an ordinary shuttle but is much shallower and has an iron fitting with two prongs pointing in opposite directions towards the tips, the prongs being bent over the face of the carrier, and lying approximately in a position occupied by the tongue of the shuttle. The weft thread is caught under the prongs and carried through the shed by the action of the pickers. A cheese of weft is placed at the back of the loom on a spindle in a position near the ground. (Ring yarns spun on pirns are placed at the top of the loom and the pirns are tipped with brass or other smooth material to ensure the absence of damage when unwinding.) It is then led upward through a pot-eye and carried to a position approximately near the carrier by a guide wheel attached to an endless chain. Two guides are attached to the chain, an equal distance from each other. The weft thread is formed by the drawing action of the guide wheel into a loop which is caught by the prong of the carrier and taken through the shed. Meanwhile, a weft-cutting device in a position almost vertical to the cheese cuts off the amount of yarn required for the width of cloth being woven. On the return journey the carrier repeats the same operation along the race board, the mechanism on the other side of the loom duplicating the movements. Interminable lengths of weft can be woven by this means. The weft is inserted in such a way that alternating threads and loops are effectively locked into the selvedge. The advantages of this method of weaving are indicated. —B.C.I.R.A.

Artificial Silk Loom Temples. *Text. Merc.*, 1926, **75**, 381.

The importance of suitable templing in weaving fabrics of or containing artificial silk is emphasised. For such fabrics as dhooties, the trough and roller temple which extends the full width of the loom gives the best results as it does not overstress the selvedge. Other suitable types of temple are indicated. —B.C.I.R.A.

Artificial Silk: Weaving. J. Kenyon. *Text. Merc.*, 1926, **75**, 383-384.

A lecture dealing with some points in the winding, drawing-in, and weaving of artificial silk. In the discussion the ability of operatives accustomed to weaving plain cotton goods to weave artificial silk was dealt with. —B.C.I.R.A.

Gabler Pirn-less Loom. Berlin-Karlsruher Industrie-werke A.-G. *Text. Merc.*, 1926, **75**, 137.

The weft insertion mechanism consists of two shafts, furnished at either end with a set of hooks. One shaft carries the weft to the middle and the other receives it and transfers it to the other side. There it is shot slightly over the edge and cut off and turned over to form the selvedge. The loom is claimed to be noiseless. —B.C.I.R.A.

Furnishing Fabrics: Weaving. *Text. Merc.*, 1926, **75**, 134, &c.

A simplified method of lacing the jacquard for weaving reversible (double warp and weft) furnishing fabrics is described. Point paper diagrams and directions are given in the case of a fabric with black and gold warps and black and gold wefts. —B.C.I.R.A.

Large Pattern Jacquard Machine. J. T. Hardaker Ltd. *Text. Merc.*, 1926, **75**, 103.

The 1800's double lift, double cylinder Jacquard described has been specially designed for weaving tapestries, brocades, and other materials with large patterns. It carries three sets of 600's cards and the cylinder is made in hexagon form and has a through steel shaft. —B.C.I.R.A.

Tubular Fabrics: Weaving. *Text. Merc.*, 1926, **75**, 65-66 (translated from *Woollen and Leinen Industrie*).

The manufacture of seamless sacks, straw sacks (mattresses), hose pipes and hosiery on power looms is discussed and is explained for a plain weave tubular fabric. —B.C.I.R.A.

Artificial Silk: Weaving. *Text. Merc.*, 1926, **75**, 6.

Some general notes on winding, warping, sizing, choice of healds and reed, setting of the loom, the use of rubber-covered temple rollers slightly bigger at the selvedge end of the temple so that the cloth is constantly being pulled outwards, the behaviour of artificial silk as weft and the choice of a satisfactory shuttle. —B.C.I.R.A.

Flax Yarns: Weaving Stresses. G. F. New and A. L. Gregson. *J. Text. Inst.*, 1926, **17**, T437-T452.

Weaving "Celanese" Silk. See Section 3A.

"Shiners" in Weaving Artificial Silk. See Section 6.

(D)—Knitting

Purl Knitting Machines: Action. J. B. Lancashire. *Text. Rec.*, 1926, **44**, No. 519, pp. 79 and 81.

Types of purl-knitting machines, their knitting action, and the production of purl designs are discussed. Vertical, square, zig-zag, and "centred" effects can be obtained on flat purl machines, but the designing possibilities are increased by jacquard mechanism, the action of which is described. —B.C.I.R.A.

Plain Circular Knitting Machine. J. B. Lancashire. *Text. Rec.*, 1926, **44**, No. 521, p. 75-77.

The modern type of automatic plain circular knitting machine for the manufacture of plain hose is described. —B.C.I.R.A.

Development of Knitting Machinery. J. B. Lancashire. *Text. Rec.*, 1926, **44**, No. 523, p. 77-79.

Bearded and compound needles, automatic mechanism for welt turning, fashioned plain hose on circular knitting machines, the development of circular knitting machines with design wheels, the production of fancy designs and other matters relating to knitting are discussed.—A.J.H.

Hosiery Products: Definition. W. Davis. *Text. Mfr.*, 1926, **52**, 230-231, 263-264.

The following terms are defined—Full-fashioned, cut-up or circular, seamless, feeder, fleecy, determination of the face and back, high splicing, English foot, French foot, bodging, press-off, shogging, tickler, throat, Milanese, warp loom, crochet, purl, &c. —B.C.I.R.A.

Hosiery: Nomenclature. W. Davis. *Text. Mfr.*, 1926, **52**, 298-299.

The following terms are defined—Flat-locking, overlocking, felling, point-to-point seam, cup seaming, lock-stitch, double lock chain-stitch, interlock stitch, interlock fabric, hemming, basting, zagging, seaming, turning-off, trimming and mounting, gusseting, shell stitching, cornelly work, fine-point seaming, welting stitch, smocking, and lacing. —B.C.I.R.A.

Hosiery Terms: Definition. W. Davis. *Text. Mfr.*, 1926, **52**, 331-332.

The following hosiery trade terms are defined—Pointed splicing, clocking, lace stitch, cellular work, Ohrenburg patterns, tinting, peroxide white, treating, ironing, transferring, boarding. —B.C.I.R.A.

"Mosspeed" Braider Carrier. Selson Engineering Co. Ltd. *Text. Rec.*, 1926, **44**, No. 521, 79.

An easily-threaded carrier for braiding machines is described in which "pigtails" replace the small holes of older types, tensioning is effected by a spring instead of a tension weight, and an eight-tooth ratchet on the bobbin replaces the usual 6-tooth ratchet. As the machine takes up yarn the spring contracts, keeping the yarn under perfect tension, and slides up the rod to a point at which it operates a release mechanism, allowing the bobbin to turn one-eighth of its circumference, and the spring drops back again and automatically re-engages the pawl with the eight-tooth ratchet on the bobbin, again holding the bobbin stationary. —B.C.I.R.A.

Merrow Shell Stitching Machine. W. Davis. *Text. Rec.*, 1926, **44**, No. 522, 69.

The action of the machine, which provides a means of finishing and ornamenting the edges of knitted garments, is described. —B.C.I.R.A.

Ladder-proof Knitted Fabrics. C. Aberle. *Melliand's Textilber.*, 1926, **7**, 835-838.

The constructions of a warp knitted fabric, a fabric produced on a Phily loom, and an inelastic fabric which combines a warp and weft system with a looped system, are discussed. The fabrics are all of the so-called ladder-proof variety, and some details are given of the looms producing them. For the purposes of hosiery manufacture it is stated that these processes are less suitable than the ordinary knitting machine processes in general use. —B.C.I.R.A.

Fidelity Multi-Design Knitting Machine. Fidelity Machine Co. *Text. World*, 1926, **70**, 477.

A true rib circular machine capable of giving 90 colours vertically and four horizontally is described. It depends on the development of the yarn selector and knot tyer device, which is made independent of the knitting elements. The machine comprises (1) a true rib knitting unit, (2) a plating unit, consisting of fingers controlling individual ends of yarns and introducing them over the needles at the will of the controlling cam, (3) a simple pattern chain governing the cams which in turn govern the introduction of plating fingers, (4) a simple pattern chain governing the horizontal striping, (5) a yarn selecting, changing, and knot tying device controlled by the pattern chain.
—B.C.I.R.A.

Striped Hosiery Machines. W. Davis. *Text. Merc.*, 1926, **75**, 99.

Machines for making vertical stripes in fancy hosiery as embroidery on the ground texture are described. —B.C.I.R.A.

Braiding Machine Tracks: Construction. W. Krumme. *Melliand's Textilber.*, 1926, **7**, 673-675.

It is shown that in braiding machines built on the Barmer system, the curved parts of the tracks, which are usually based on the arc of a circle, may be advantageously replaced by tracks of which the basic curve is a parabola or an ellipse.
—B.C.I.R.A.

Knitted Goods: Seaming. W. Davis. *Text. Merc.*, 1926, **75**, 37 and 67.

(1) An explanation of the chain, lock, and double-lock stitches used in sewing up knitted garments. (2) An explanation of the point-to-point method of seaming knitted goods. The stitch in one edge has its counterpart in the other, and each point in the machine holds a pair of loops which the seaming threads of the machine then join together. The Hepworth system of point-to-point seaming is described.—
—B.C.I.R.A.

Knitted Goods: Fashioning. W. Davis. *Text. Merc.*, 1926, **75**, 5.

On flat knitting machines fashioning is often performed by hand with what are known as the ticklers, but on power machines there are sets of points which are made to work entirely automatically. The frame ceases from its ordinary knitting action and the central shaft moves into position a new set of cams, which operate the stitch-forming parts and the fashioning devices. The points descend and receive the edge stitches. They then rise, moving the required loops to right or left, and descend again to replace those stitches on the needles. The main shaft moves the ordinary knitting cams back into position. The angle of fashioning is determined by the gauge of the machine on which the goods are knitted, and depends largely on the number of courses per inch. Some practical examples of fashioning are discussed.
—B.C.I.R.A.

Knitted Fabrics: Gauging. W. Davis. *Text. Merc.*, 1926, **74**, 558-559 and 593.

The different systems are discussed. In the original hand stocking system the number of leads on three inches was taken as the gauge of the machine, and since each lead carried two needles the number of needles or stitches per inch was two-thirds of the gauge number. The Cotton's patent frame adopted this system, but considerable confusion has been caused by the arbitrary methods adopted by the builders of circular frames. Further confusion was due to the adoption of the French and German inch by French and German machine builders. In general, there is a growing tendency to gauge on one or two simple systems, for circular frames the needles per inch of circumference, and for flat frames of the Cotton's patent type the number of two-needle leads on three inches. American systems of gauging are indicated, and tables of gauges for French and German circular frames (spring needle), and a table showing the needles per inch, the corresponding English Cotton's patent gauge, and the equivalent gauge numbers in the French system are given. Instructions are given for calculating the width of a given number of needles in any gauge. —B.C.I.R.A.

(E)—Lacemaking and Embroidering

Cornelly Embroidery Machines. W. Davis. *Text. World*, 1926, **69**, 4101-4102.

Methods of embroidering knitted fabrics with a type of machine which works a kind of crochet chain stitch on the fabric are described. Patterns making use of simple chain stitch, corded designs, and moss stitch are shown. —B.C.I.R.A.

(F)—Subsequent Processes

Cotton Cloth: Desizing. H. C. Roberts. *Text. World*, 1926, **69**, 581-583.

A general article on the preparation of cotton piece goods for jig dyeing, dealing with the removal of starch by enzymes and desizing in jig and padding machines.
—B.C.I.R.A.

(G)—Fabrics

Artificial Silk: Application. H. E. Fayes. *Text. World*, 1926, **70**, 2013-2014.

Artificial silk has rapidly become a valuable adjunct to cotton goods, giving them tone, life and style value. It is finding increasing application not only in the manufacture of dress fabrics but also in upholstery fabrics, especially in bedspreads and curtain materials. Among the new artificial silk fabrics mentioned are a shaded celanese voile, a celanese moiré, and for upholstery purposes artificial silk damasks and artificial silk taffeta, which is a combination of silk and artificial silk. —B.C.I.R.A.

Gauzes: Weaving. J. Schroeder. *Textielindustrie*, 1926, **7**, 766-772, 815-822, 925-933, and 990-994.

The article deals with true gauzes which are defined as fabrics in which the warp threads are not allowed to lie parallel but are twisted or looped round one another so that they keep their positions better and give a more uniform appearance to the fabric. The twisting or looping may be simple thread crossing, half-thread crossing (crossing at the junction with weft) or double-thread crossing; in addition, two systems of warp threads are distinguished, namely, "twist" or "loop" warps and "ground" or "fixed" warps, which allow of further variations in the weave. Point paper diagrams and illustrations are given showing the building up of various gauze patterns from these systems. Warp threading devices for gauze weaving are then described, beginning with simple warp supporting devices and including an English heald system and a system with healds of drawn wire. For the more complicated weaves (having the appearance of "aertex" fabrics) dobbies are required and suitable machines and methods of lacing are described. The method of regulating the tension of the loop threads is indicated. The article concludes with directions for weaving figured gauzes on a Jacquard. —B.C.I.R.A.

Artificial Silk-bordered Dhooties. *Text. Merc.*, 1926, **74**, 590.

Dhooties with artificial silk borders are finding increased favour in India. Photographs of plain and figured artificial silk borders to dhooties are reproduced. —B.C.I.R.A.

Cotton Fabrics: Thermal Properties. J. Gregory. *J. Text. Inst.*, 1926, **17**, T553-T566. —B.C.I.R.A.

PATENTS

Gabler Loom Weft Inserting Mechanism. J. Gabler. U.S.P.1,515,102 (from *Text. World*, 1926, **70**, 2062).

The weft is inserted double to the centre of the shed by a "weft rod" in the end of which is a thread eye. At the centre of the shed the weft is caught by a hook device entering from the other side of the loom. A cutting mechanism is provided to sever this pick from the preceding one, and the pick is drawn across the shed by the hook device. When the hook has reached the outer edge of its travel, the lay has beaten up the pick, the cut end of which is still held by the hook which, when it starts back across the shed, doubles back the end which is beaten up with the next pick to form a double pick in the selvedge. Means are provided for preventing the weft from coming off the supply package when the weft rod is on its return stroke. The knife and the weft gripping devices are operated by a cam motion through a series of lever arms and a tappet arrangement. The travel of both the weft rod and hook is governed by a cam motion. —B.C.I.R.A.

Shuttle Propelling Device. J. Descours. F.P.597,850.

The driving of the steel guide cocking the picking stick, or of the rack driving the shuttle, is secured by the rotation of an eccentric disc with a finger acting on a block. A special device actuates, during the rotation of the main shaft, a regular drive. —Bur. Text.

Fabric Knitted with Warp and Weft Yarn. G. Sarti. F.P.598,096.

This patent refers to a knitted fabric in which are inserted warp and weft yarns. A delivery of yarn is made, simultaneously or alternately, on each side of the knitted fabric, so that the warp or weft yarn are inserted across each range of meshes. —Bur. Text.

Weft-changing Mechanism. E. Hollingworth, Dobcross (Dobcross Loom Co. and Crompton & Knowles Loom Works, U.S.A.). E.P.255,965.

A pick-and-pick loom having a set of shifting shuttle-boxes at each end of the lay and a multi-colour magazine, comprises means to select a weft-carrier corresponding in colour to the running shuttle, and means to transfer it to the said shuttle when required, the selecting means operating independently of the positions of the shuttle boxes and being controlled directly from the pattern mechanism. The loom is of the type having drop boxes and detector-mechanism at one side, and horizontally-moving boxes and a multi-colour weft carrier magazine on the opposite side. The boxes on either side are actuated by chains from the usual box levers controlled by the pattern chain. —B.C.I.R.A.

Shuttle Threading Device. L. Lenton, Coventry. E.P.255,985.

The device comprises a handle bored to receive a steel magnet, from which projects a short piece of iron wire, and an implement such as the eye of a darning needle secured to an endless loop of cotton. In use, the weft is passed through the loop and the magnetised wire is passed through the shuttle eye and attracts the implement, which is drawn through the eye with the weft. —B.C.I.R.A.

Knitting Machine Knot Tying Device. W. Spiers, Leicester. E.P.255,994.

A knot-tying device combined with a knitting machine, as described, for example, in Specifications 220,366 and 239,268, and operating in conjunction with yarn-changing means, is provided with means for moving the knot away from the severed ends of the yarns before it is tightened. A brush carried by a spring-pressed pivoted arm is disposed adjacent to the

rotary knot-tying device. The arm is engaged by a pin on a lever which is operated by the lever actuating the knotting device in the manner described in Specification 239,268. —B.C.I.R.A.

Tubular Knitted Fabrics. W. Spiers, Leicester. E.P.255,999.

Tubular fabric made preferably on circular machines comprises in combination ribbed portions and patterned or fancy portions with or without intermediate portions. The fabric is knitted in one continuous operation on one machine. The ribbed portions may be hosiery tops and the patterned portions the legs. —B.C.I.R.A.

Circular Knitting Machine Gear Wheels. T. S. Grieve, Leicester. E.P.256,016.

In circular knitting machines of the double end-to-end needle cylinder type where gears are used for the transmission of motion from one needle cylinder to another, the gears are of the kind formed in sections capable of relative circumferential adjustment to eliminate back-lash. In a preferred gear wheel formed in two sections held together by screws passing through slots in one of the sections, angular adjustment between the sections is obtained by an inclined screw in this section adapted to bear on the bottom of a recess in the other section. According to the Provisional Specification, the adjustment gear may be applied to chain wheels. —B.C.I.R.A.

Fabric Folding Machine. W. H. Worrall, Manchester. E.P.256,051.

In a machine for creasing and doubling fabrics, the triangular creasing block is movable laterally, and the bar, guide, or winch adjacent to the block is hinged, the bar and block, &c., being interconnected so that they can be adjusted simultaneously. —B.C.I.R.A.

Knitting Machine Stop Motion. W. J. Mellersh-Jackson, London (for Nationale Mécanique Soc. Anon., Brussels). E.P. 256,061.

In order to stop an electrically-driven parallel knitting machine on failure of yarn, occurrence of a knot, after a desired number of revolutions or at other times, clutch parts normally connecting a motor to the driving shaft are disengaged by means of a trip device controlled by an electromagnet. The motor, the clutch, and the trip mechanism form a separate unit capable of attachment to a hand knitting machine. —B.C.I.R.A.

Loom Picker. F. Masarnau and R. Deloustal, Barcelona, Spain. E.P.256,168.

Pickers are made from two rectangular pieces of buffalo leather which are perforated and folded in accordance with given directions. The assembled parts are shaped under pressure in a mould to form the picker, having a tubular part for receiving the picking spindle, a head strengthened at its ends, and a slot for the picking strip. After moulding, the picker is trimmed to shape. —B.C.I.R.A.

Tentering Chain. Mather & Platt Ltd. and S. F. Barclay, Manchester. E.P. 256,368.

The joint-pins of tentering chains have a tapered reduced portion to receive a sleeve or bush having a parallel bore and an external reverse taper, the pin and bush being forced into the upper plate of the clip and the upper part of the bush being riveted or spun over, thereby securing the pin and forming an oil-tight joint. The pins are made of hard steel and the bushes of soft steel or metal. In a modification, the bush has a closed outer end —B.C.I.R.A.

Coloured Border Weft Fabrics: Weaving. Morton Sundour Fabrics Ltd. and J. Morton, Carlisle, and J. B. Webster, Lancaster. E.P.256,390.

Fabrics are woven with two coloured border wefts which are looped round a body weft inserted by a shuttle. The border wefts, one at each side of the loom, are drawn from cops, over tensioning bars, through tensioning rings, through eyes at the lower ends of adjustable bars, through openings in vertically-movable slackening bars, and through the reed to the fell of the cloth. The border wefts may be introduced at certain picks only. —B.C.I.R.A.

Warp Letting-off Mechanism. W. Kirkpatrick, Keighley. E.P.256,398.

In let-off mechanism of the type in which the warp beam is rotated by means of gearing from a shaft provided with a ratchet wheel engaged by a pawl on a lever actuated by a rod from the lay sword, &c., the extent of movement of the ratchet wheel being governed by a shield on a lever controlled by the warp tension, an eccentric fixed to the shaft carries a wheel and pinion which are formed integral with one another. The pinion gears with internal teeth on a wheel gearing with a wheel on the warp beam, whilst the wheel gears with internal teeth on a fixed casing. The second wheel and warp beam are thus rotated to let off warp when the shaft is rotated, but the wheel cannot transmit back movement to the shaft. —B.C.I.R.A.

Colour Printed Yarn: Application. A. A. Richards, Bournville, Birmingham. E.P. 256,471.

Variegated fabrics, &c., are made by knitting or weaving yarn which has previously been dyed or printed in such a way as to produce the required design in the finished fabric. A yarn to serve as a pattern for use in the dyeing of knitting yarn may be obtained by knitting a fabric in white wool, colouring it and finally unravelling it. For woven fabrics, &c., the warp and/or the weft is printed in sheet form. The yarn used may be thickened at intervals. —B.C.I.R.A.

Picker-checking Device. E. A. Perrin, La Bresse, Vosges, France. E.P.256,567.

A strap which is adjustably secured at one end to a helical spring attached to the shuttle-box passes through ears in a sheet-metal bracket attached to the end and back of the shuttle box. The other end of the strap is slotted so that it may be folded on itself and passed over a short strap passed round the picking-spindle, the parts being secured by a pin. An additional strap slotted at one end is arranged to form a running knot on the picking spindle, the free end of the strap being adjustably secured to the shuttle-box back. —B.C.I.R.A.

Circular Knitting Machine Plating Mechanism. Hemphill Co., Rhode Island, U.S.A. E.P.256,612.

Reverse plated goods with continuous or interrupted vertical stripes are produced by the use of two or more sets of web holders with inclined nibs which, when projected in advance of the ordinary cam, reverse the position of the new loops of yarn. This action can be sometimes assisted by the use of a forward hook needle at the beginning of the normal plating stripe and a centre hook needle at the ending edge of a reverse plating stripe. Standard web holders are used where stripes extending the length of the fabric are desired. Horizontal non-plated stripes can be obtained by changing the yarns. —B.C.I.R.A.

Ribband-form Sizing Compound. W. Acton, Paisley. E.P.256,747.

Materials other than soaps for finishing, dressing, or laundering textile fabrics are manufactured in ribband form, so that a given length or area thereof represents a given weight. The sheets may be cast or moulded and then cut to any desired length. In an example, 10 lb. of white farina dextrin are dissolved in 6 lb. of hot water, and thoroughly mixed with a hot solution of 10 lb. of clear gelatin in a mixture of 5 lb. of water and 5 lb. of glycerol to which 1 oz. of benzoic acid is added. The mixture is allowed to cool to 70° and is then poured on to a waxed glass plate to form a layer about $\frac{1}{8}$ in. thick. Finally, the cold sheet is cut into strips about 1·2 inches wide and 43 inches long which, after drying at a low temperature, become an inch wide and a yard long. —B.C.I.R.A.

Warp Tensioning Device. E. Hollingworth, Dobcross. E.P.256,749.

The warp in heavy looms, such as carpet looms, is tensioned by being passed diagonally through a longitudinal slot with rounded edges in a cylindrical roll turning in bearings in the loom frame and provided at each end with the bosses of weighting levers. Narrow steel supporting plates may be cast in with the roll. The roll may be built up from two members clamped together by end caps in such a manner as to provide a slot between them, and it may be acted upon by adjustable springs in addition to or instead of the weights. —B.C.I.R.A.

Shuttle Stop Motions. Vereenigde Textiel-Maatschappijen Mautner, Rotterdam, and F. Souczek, Reichenburg, Czecho Slovakia. E.P.256,807.

The arms, tongues, or daggers on the stop-rod are normally retained in raised positions, and only fall into position to engage the frog when the shuttle does not work properly. The arms are raised by means of rollers on spring-controlled levers pivoted on arms on the lay swords. These spring-controlled levers contact with fixed stops, but as the lay advances, move towards the swords in the manner shown. If the shuttle is properly boxed it actuates a feeler and bell-crank lever which is thus turned into position to stop the movement of the corresponding spring-controlled lever towards the swords before the lever has moved sufficiently to allow the corresponding arm to fall. If the shuttle does not actuate the feeler the spring controlled lever moves so far towards the lay, as this advances, that it allows the arm to drop and engage the spring-loaded frog provided. —B.C.I.R.A.

Weft Stop Motion. Soc. Alsacienne de Constructions Mécaniques, Mulhouse, Haut-Rhin, France. E.P.256,932.

A bent feeler-lever, having a pivoted head, is pivoted in a slidable casing and is normally spring-pressed against a stud thereon. The casing slides on guides on a bracket and has pin and slot connection therewith. At the beat-up, the feeler engages an arm on a spindle to rotate the same for the purpose of stopping the loom or initiating weft replenishment. —B.C.I.R.A.

Parallel Knitting Machine Thread Guide. O. Bongi, Florence, Italy. E.P.256,948.

The thread guides are controlled by means of small plates attached to the jacquard cards. These plates engage one or other of pins carried by a block on the underside of which is a rack gearing with a pinion on a shaft. The pins are of different lengths. The shaft is connected to a striker, which is thus turned a variable amount to engage one or other thread-guide carrier as desired. —B.C.I.R.A.

Duplex Loom. J. de Zulueta, Valladolid, Spain. E.P.257,363.

In a duplex, vertical shuttleless loom for weaving two cloths simultaneously, the two warps, after passing through warp stop-motion apparatus, pass over guide-cylinders to healds, thence through a reed carried by frames which are vertically reciprocated along guides of spaced benches by means of arms and eccentrics on a shaft. The woven cloths pass over guide rollers to take-up mechanism. The healds are

operated by eccentrics on a shaft driven by chain gearing from the first shaft. The weft is inserted by two flexible guide-needles, one for each fabric. The weft-inserting and selvedge-forming arrangements are described. The loom is driven by an electric motor through reduction gearing and a shaft connected by a spring-controlled clutch to the first shaft. The clutch comprises two plates having rounded projections on their engaging faces.
—B.C.I.R.A.

Loom Picker. J. Walton and A. Sutcliffe, Todmorden. E.P.257,410.

A method of folding a raw hide blank and inserting a folded piece of raw hide to form a picker is indicated. The striking face for the shuttle may be arranged centrally or at one side of the picker.—B.C.I.R.A.

Pirnless Weft Inserter. A. Mullor, Sceaux, and L. Carriol, Paris. E.P.257,476.

In continuous weft-feeding devices as in Specifications 249,471 and 253,861 the "shuttle" is provided at each end with a thread-gripping fork with inclined parts and recesses facing inwards, so that when the "shuttle" moves to the right, the thread presented by an eyelet on a fixed rod is engaged by the left fork and carried in loop form through the shed, whilst when the "shuttle" moves to the left, the weft is engaged by the right-hand fork. The weft at each side of the loom is passed through an eyelet and is tensioned by being passed through a brake comprising fixed jaws and movable jaws on a spindle, which is connected by lever mechanism to extended parts of the "abutment" shaft controlled by a spring and by levers and swells. When the "shuttle" boxes, the "abutment" shaft is turned and the movable jaws grip the thread against the fixed jaws, but when the "shuttle" is picked the jaws release the thread. —B.C.I.R.A.

Air Filtering Fabrics: Weaving. Hoover Ltd., London. E.P.257,484.

Fabrics for use as air filters have loosely-twisted wefts and hard-twisted warps. The fabric is woven multi-ply with alternate large and small wefts in each ply, a large weft in one ply being situated above (or beneath) a small weft in the other ply. Face warp yarns, back warp yarns, and binder warp yarns are used. The fabric may comprise more than two plies.
—B.C.I.R.A.

Loom Shedding Motion. A. C. Rife, Barcelona, Spain. E.P.257,575.

Tappets on a shaft journaled in a frame on the top of the loom actuate levers, each of which is connected to one of the healds of the loom. The shaft carries a ratchet which is actuated by pawls during each movement of a weighted lever actuated from the loom. The shaft drives a star wheel which co-operates with rollers on a lever to act as a retention-and-escape mechanism. The latter lever is actuated in time with the weighted lever. A brake is provided on the shaft to modify the abrupt action of the heald springs.
—B.C.I.R.A.

Size Mixture: Preparation. M. I. Aische, Congleton, Cheshire. E.P.257,682.

Sizes for textiles comprise metallic or alkali soaps or rosinates, or soaps such as those described in Specification 255,508 with an alkaline solution and an aldehyde with or without alcohols or a fatty ester such as spermaceti. Starch, gums, resins, dextrins, china clay, &c., may be added. Insoluble soaps or solutions of alkali soaps may be used. As aldehydes, formaldehyde, acetaldehyde, benzaldehyde, chloral hydrate or furfuraldehyde may be used. For addition, alcohols such as methyl, ethyl, or acetyl alcohol, glycerol, cholesterol, phytosterol or sitosterol, with or without a solvent such as the chloroethanes are suitable. In an example, sodium hypochlorite is also employed. —B.C.I.R.A.

Weft Cutting Mechanism. British Northrop Loom Co. Ltd., Blackburn. E.P.257,733.

The temple thread-cutter of an automatic weft-replenishing loom is normally held inoperative by a latch controlled by a device on a fixed part of the loom which is operated by the detector-mechanism to release the cutter for a number of picks while it is gradually shifted, by connections from the lay, back to inoperative position. The cam and lever mechanism is described in detail. —B.C.I.R.A.

Jacquard Heald Under Motion. Carver Textile Patents Ltd. and T. A. B. Carver, Openshaw, Manchester. EP.257,737.

To return the warp threads to their lowest position after shedding in a shedding motion of the jacquard or analogous type, the heald or harness cords, after passing through a comber board or section, are each attached to a spring. These springs are enclosed in containers and anchored to the bottoms thereof, the containers being suspended from the comber board. Each container may comprise a wooden frame board at the top for the passage of the suspending cords. The upper ends of the healds may be adjustably attached through short cords to clips above the sectional comber board to enable the harness cords to be removably attached. —B.C.I.R.A.

Double-walled Stocking Fabric: Knitting. J. M. Allen, Toronto, Canada. E.P. 257,794.

Double-walled hosiery is made by first knitting the outer layer, on a circular machine, with a tubular welt and a free fabric strip, reversing the article on a form so that the strip comes on the outside, and drawing a separately knitted lining over it. The two layers are seamed together longitudinally by stitches and the top edge of the lining is united to the edge of the

free strip in a looping machine. The welt is made by suspending loops from alternate needles on radial bifurcated instruments. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

Weaving—

256,438. M. B. Lloyd. Circular looms; looms for weaving wickerwork.

Fabrics—

256,416. W. Ebell. Driving and conveyor belts.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming

Artificial Silk: Lubricating, Scouring, and Dyeing. H. C. Roberts. *Text. World*, 1926, **70**, 2021-2022.

The uses of oils and oil products in connection with artificial silk are discussed. Oils are used to lubricate yarns prior to winding and the soaking, roller trough, wick and spray methods of application are briefly described. In the subsequent removal of the lubricant the most efficient scouring agent is a high grade, specially prepared sulphonated oil and a mild emulsifying agent such as sodium triphosphate. The use of a sulphonated oil in the dyebath is beneficial in dyeing light shades. —B.C.I.R.A.

Degumming and Dyeing Natural Silk. I. Ginsberg. *Text. Colorist*, 1926, **48**, 749-751.

Brief details of technical methods for degumming and dyeing natural silk. —A.J.H.

Oil and the Wool Fibre. W. F. Vickers. *Text. Rec.*, 1926, **44**, No. 520, p. 109.

Olive oil is the best oil for lubricating wool, but does not scour out so easily as commercial oleine. For practical purposes an oil somewhere between these two is suggested as being the best, depending on the quality and type of material used A good quality oil, supplied from oil manufacturers who go thoroughly into research, should be used and everything eliminated which may tend to cause oxidation or polymerisation. It should be applied intimately mixed with water in the form of a fine emulsion, and this sprayed on the pile of the wool by one of the latest spraying machines. —B.R.A.W. & W.I.

(C)—Washing

Washing and Scouring Machine. Hill and Herbert Ltd. *Text. Merc.*, 1926, **75**, 101.

The machine is so arranged that it is serviceable for treating the most delicately-formed materials and staple fibre in the loose state. The chief feature is the provision of a travelling brattice and a pair of squeezing rollers, the lower of which may be covered with hemp, with a top covering of spun yarn. Alternatively, the rollers may be rubber-covered or encased in sheet brass. When the rollers are covered with hemp and spun yarn they exert a gentle but effective pressure on the material. The travelling brattice conveys the material automatically upwards towards the squeezing rollers. —B.C.I.R.A.

Washing of Inferior Woollen Goods. S. Reinhard. *Melliand's Textilber.*, 1926, **7**, 621 (from *Z. Ges. Text.-Ind.*, 1925, **28**, 593).

Special difficulties which arise when washing cheap worsted goods and their causes are described. Short fibres, acid residue from carbonisation, the presence of oils, as also the use of fugitive cheap dyes must be considered whilst washing these goods. Washing at high temperatures should be avoided. One method consists of saponifying the free fatty acids of the spinning oils with soda and using the soap thus formed as cleansing reagent. According to the author it would be expedient to allow for the presence of quantities of free fatty acids in the oils used for spinning and pulling, which are easily saponified and may then be used as an emulsifying agent for unsaponifiable oils. Many difficulties can be overcome in the cleansing of woollen goods if the wool-oil used is carefully chosen. Also a small addition of caustic soda in the first stage of washing may prove advantageous but not more than 1 : 1000 may be used. Alcohol, carbon tetrachloride, ethane tetrachloride or the like help in the reaction. The unpleasant odour in storehouses can in most cases be traced to incomplete washing of the woollen goods. The author considers the use of Olein unsuitable, as its quality and composition varies and does therefore not give even results. —B.R.A.W. & W.I.

(E)—Drying and Conditioning

Cylinder Drying Machine: Description. Dod Brothers. *Text. Merc.*, 1926, **74**, 562-564.

The machine is of the usual type but has new patent doll-heads, a multiple ball bearing rope drive and a direct system of steam supply. It operates at increased speed so that the period during which the fabric is in contact with a cylinder body is considerably reduced, and improved results are obtained in the finish. It would appear from the results that the ideal method of drying in order to obtain the best finish is to use a large number of cylinders and to pass the fabric through at a high speed. —B.C.I.R.A.

Dollhead Adapter. James Gent & Son. *Text. Merc.*, 1926, **75**, 570.

Dollheads which are almost beyond repair can be brought to maximum efficiency

by means of the adapter which can be fixed at a cost of little more than the usual method of bushing. It consists of a double ring of cast-steel fitted with ball bearings. One ring is shrunk on the inner end of the old dollhead, which has been shortened and machined on the outside. The second ring is split and provided with lugs to clip the ball bearing. The connection between the two rings forms an oil well half the depth of the whole. The packing is built up of anti-friction split metal rings of special design and alloy alternated with asbestos rings to fit them. This arrangement forms a solid ring closely embracing the nozzle with a minimum of pressure, yet remaining perfectly steam-tight. The work of conversion can be carried out in the purchaser's own works. —B.C.I.R.A.

"Turblex" Hose-drying, Cooling, and Conditioning Machine. Tomlinson's (Rochdale) Ltd. *Text. Mfr.*, 1926, **52**, 307-308.

The machine comprises an insulated tunnel constructed of steel sheets and rolled-steel sections in which conveyors are mounted which move through the tunnel continuously at a uniform speed, the hose or other small articles being fed to them by hand or by mechanical means. The conveyors are generally of lattice type. In the usual type of machine they move forward in a horizontal plane and deposit the dried goods in a removable receptacle. Drying is carried out on an elaboration of the counter-current principle. The air is heated by Turblex steam-heated gilled pipes and is impelled along spiral paths by fans located within the machine. When in the dry state the hose may, if desired, be carried by the conveyors through an intermediate cooling zone into a section of the tunnel where scientific rehumidification takes place, and where provision is made for controlling accurately the percentage of moisture returned to the goods. The low consumption of steam for drying purposes is a feature of the machine, only 1½ lb. of live steam being needed to evaporate each pound of water. —B.C.I.R.A.

Wool: Moisture Regain. S. G. Barker and J. J. Hedges. *J. Text. Inst.*, 1926, **17**, T453-T456.

(G)—Bleaching

Bleaching Cotton with Permanganates. *Text. Rec.*, 1926, **44**, No. 524, p. 63.

In bleaching with permanganates an improved white is obtained, especially with Egyptian cotton, by the following modification of the usual method. Cotton is steeped overnight in a cold solution containing 8-10% of caustic soda (calculated on the weight of cotton), washed, soured, then worked in a solution containing 7% of potassium permanganate and 10% of concentrated hydrochloric acid, rinsed in water and then worked in a solution containing 5·5% of sodium bisulphate and 15% of hydrochloric acid; afterwards the cotton is returned to the permanganate solution after the addition of 5% of alcohol. Finally, the brown cotton is immersed in an acidified solution of sodium bisulphite, whereby it changes to a pure white. —A.J.H.

Bleaching Vegetable Fibres with Perborate; Catalytic Action of Metals——. *Text. Rec.*, 1926, **44**, No. 524, p. 66.

The deleterious action of solutions of perborate on linen is considerably increased by the presence of copper or iron, but not by iron if copper is also present. The presence of the sodium salts of fatty acids (soaps) inhibits the catalytic action of copper salts, although the bleaching action of a solution of perborate is increased by the addition of a soap. —A.J.H.

Kier Temperature Control Device. F. W. Sturtevant. *Text. World*, 1926, **70**, 2,063.

The regulators are of the self-contained type and have lever-weight adjustment, allowing the temperature desired to be changed at will. The expansion tube or "bulb" which projects into the kier contains a sensitive fluid hermetically sealed, which generates a pressure due to the heat of the liquid in contact with it. This pressure is communicated through a flexible connecting tube to the bonnet of the steam valve. The bonnet is equipped with an all-metal bellows diaphragm which responds to the pressure changes by closing or opening the valve so as to maintain the desired liquid temperature. The valve is of the double-seated balanced type. A thermometer is placed in the side of the kier so that a visible check may be kept on the efficiency of the regulator. —B.C.I.R.A.

Rayon and its Bleaching. W. B. Nanson. *Text. Amer.*, 1926, **45**, No. 4, p. 55.

"High temperatures should be avoided" is emphasised, and it is advised that the goods after steeping at 115° F. should be boiled in a high-pressure kier for six hours with a 3% soda solution, and after souring, washed in hypochlorite of ½-1° Tw. Sodium bisulphite may be used for antichlor. Peroxide of soda is also recommended. —F.G.P.

Bleaching Preparatory to the Printing of Silk Goods. *Text. Colorist*, 1926, **48**, No. 569, p. 331.

Silk is immersed for 12 hours in a bath of 200 parts of water containing a little ammonia or borax, and 50 parts of 10-vol. hydrogen peroxide. It is turned and left again for 12 hours. The temperature is then raised to 120° F. and steeping continued for another three hours. If not sufficiently bleached the operations are repeated. —F.G.P.

Bleaching of Wool with Sulphur Dioxide. E. F. H. Cook. *J. Text. Inst.*, **17**, T371-T378.

Bleaching of Wool with Sulphur Dioxide and Sulphurous Acid, and a Note on the Presence of a Carbonyl Group in Wool. J. L. Raynes. *J. Text. Inst.*, **17**, T379-T385.

Relation of Physiological Properties of Cotton to Bleaching. See Section 1C.

(H)—MERCERISING

Cotton Cloth: Mercerisation. T. P. Gates. *Text. World*, 1926, **69**, 3,631.

In an investigation on eight-inch squares of several types of cloth it was found that—(1) The greatest saturation is obtained at 19% of caustic soda by weight, greater concentrations being wasteful and detrimental to quality owing to poorer shrinkage. (2) Temperatures above 25° C. are satisfactory; below 25° C. is detrimental, so that the necessity for cooling is removed. (3) Carbonates have a bad effect on shrinkage but are not detrimental unless they exceed 8% of sodium oxide as carbonates. (4) The saturation is complete to the extent of 95% in 30 seconds, so that an important saving in time may be effected. (5) Twist has no bearing on the time of optimum saturation for practical purposes. (6) The shrinkage of dry unboiled fabrics is very poor, and wet unboiled fabrics make it difficult to maintain a constant concentration of alkali, so the samples were run in the dry boiled state. (8) The greater the stretch at the point at which the caustic in the cloth is diluted with water sufficiently to relieve the tension, the better the lustre. The length of the stretching frame then becomes the main controlling feature which regulates speed of mercerisation, the longer the taper on the stretching frame the higher the speed. —B.C.I.R.A.

"Frebevoe" Gray Cloth Mercerising Process. F. B. Voegeli. *Text. World*, 1926, **70**, 1891.

Gray cloth is run from the singeing machine through a hot solution of caustic soda of 80° Tw. (at 60° F.), in a stretched condition. Saturation is accomplished almost instantaneously, after which cold water is run over the material until the temperature reaches about 50° F. The caustic soda is thus diluted to a mercerising strength and mercerisation begins as soon as the temperature has been reduced. After mercerisation has proceeded to the desired point, the cloth is run directly into the boiling-out kier. It is claimed that the kier boiling time may be shortened considerably because of the impurities dissolved by the hot, strong caustic soda solution during mercerisation. Heating the lye increases its solvent and penetrating properties so that it is forced to penetrate the material. —B.C.I.R.A.

(I)—DYEING

Colorimetry. J. Guild. *Sci. Abs.*, 1926, **29A**, 315 (from *Trans. Opt. Soc.*, 1926, **27**, 130-136 and 139-155).

The author contends that, from the practical standpoint of quantititative colorimetry, hue and saturation are not the fundamental elements of colour quality, but must be regarded merely as derivatives of the trichromatic constitution of the colour. Practical and theoretical reasons are advanced to show that whatever may be the advantage of specifying colour quality by hue and saturation, there are grave objections to practical methods of colorimetry involving the direct measurement of saturation. In a subsequent paper, a new method is described of determining the quality of a colour, as defined by its position on the trichromatic colour chart, in which only the colour-matching properties of the eye are involved. The determination depends on two colour matches in each of which the test colour is matched by a mixture, in unknown proportions, of a standard colour and a monochromatic colour obtained spectroscopically, a different standard colour being used for the two matches. An instrument is described in which the method is embodied. —B.C.I .R

Cop Dyeing Machine. Bradbury, Saunders Ltd. *Text Rec.*, 1926, **44**, No. 519, p. 96.

The pan is entirely self-contained and stands on cast-iron supports, the pipes being connected underneath. The flow of the dye into the pan is so distributed that harmful currents are obliterated and no eddies or frothing appear. The pump is a well-designed centrifugal and the stuffing box is a separate unit securely bolted on to a machined face on the pump body. The machine may be belt or motor driven. In the two-plate machines 500 weft or 380 twist cops can be dyed at one operation. In the four-plate, 1,000 weft or 760 twist, and in the six-plate, 1,500 weft or 1,140 twist. The dyeing takes from 10-15 minutes. Vacuum extraction pans having a novel automatic flap valve for drainage can be supplied. —B.C.I.R.A.

Dyeing of Knit-goods: Recent Developments. S. R. Trotman. *Text. Rec.*, 1926, **44**, No. 523, pp. 97-99.

The application of Neolan, Solidon, Naphthol AS, Ionamine, S.R.A., Celatene and Duranol dyes to knitted materials is discussed. —A.J.H.

Hosiery Dyeing and its Problems. *Text. Rec.*, 1926, **44**, No. 524, p. 65.

Some general notes on practical methods. —A.J.H.

Animalised Cotton. *Text. Rec.*, 1926, **44**, No. 524, p. 67.

Immunised cotton (i.e., cotton esterified by treatment with an alcoholic solution of

caustic soda and *p*-toluene sulphochloride) reacts with ammonia whereby the *p*-toluene sulpho residue is eliminated and amidated cotton is formed. Amidated cotton has a strong affinity for acid wood dyes, particularly the acid chrome and pyrazolone types, the resulting dyeings being of satisfactory fastness to soaping. —A.J.H.

Formaldehyde in Dyeing Souple and Ecru Silks. *Text. Colorist*, 1926, **48**, No. 567, p. 182.

A preliminary treatment with dilute formaldehyde renders the gum insoluble and it is said that the silk may be dyed in hot soap baths without loss of sericin. —F.G.P.

Improving the Fastness against Water of Silk dyed with Basic Dyes. *Text. Colorist*, 1926, **48**, No. 567, p. 184.

Dyed silk is often required to stand soaking for 12 hours in water without discolouring the liquid. Basic dyes do not come through this successfully. Mordanting with tannic acid and tartar emetic before dyeing has been discovered to add to the fastness of basic dyes, though it dulls the shade to some extent.—F.G.P.

Substitutes for Boiled-off Liquor in Silk Dyeing. *Text. Colorist*, 1926, **48**, No. 567, p. 184.

When boiled-off liquor is not available, tin weighted goods may be dyed in a bath containing sodium phosphate. Unweighted silk may be dyed in a mixture of Marseilles soap and gelatine. Ammonium acetate is also said to be useful. —F.G.P.

Dyeing of Rayon. *Text. Colorist*, 1926, **48**, No. 568, p. 257.

Nitrocellulose rayon may be dyed with basic colours without mordanting, but the other varieties require the usual tannin-tartar emetic treatment. —F.G.P.

Notes on the Dyeing of Natural Silk Fabrics. R. Sansone. *Text. Colorist*, 1926, **48**, No. 569, p. 310.

Describes dyehouse methods when the supply of water is short. —F.G.P.

Dyes for Artificial Silk. C. F. Green. *Text. Colorist*, 1926, **48**, No. 569, p. 324.

Gives a list of English dyes and their American equivalents that are level—and moderately level—dyeing on viscose. Very few blues are included as these are practically all classed as uneven dyes. —F.G.P.

Sodium Silicate and Chromium in Silk Dyeing. *Text. Colorist*, 1926, **48**, No. 569, p. 328.

Silk mordanted with chromium chloride is said to be less harsh and to have more lustre than when bichromate is used. A cold solution of 2° Tw. is used in which the silk is steeped for 12 hours. A second cold bath of sodium silicate of 1° Tw. is used in which the rinsed silk is immersed for 30 minutes. The goods are rinsed and then dyed. It is stated that there is no injurious effect on the fibre. —F.G.P.

Effect of Sunlight on Wool. I. Ginsberg. *Text. Colorist*, 1926, **48**, 667-670 (from *Melliand's Textilber.*, 1925, **6**, 745).

The effect of sunlight on the dyeing properties of wool are discussed mainly with reference to the results obtained by Bergmann. —A.J.H.

Dyeing Cotton Piece Goods with Artificial Silk Effects. *Text. Amer.*, 1926, **45**, No. 3, p. 61.

Because rayon will not stand tension when wet nor high temperatures, it is suggested that the piece be placed in a tin basket in a bath of boiling water, then steamed and allowed to cool in the tin. The fabric may then be dyed in a bath containing 5-15% glauber, ½% soda, 1-2% monopol soap, and 2% olive oil. Unless mercerised cotton is used, level dyeing will be difficult. —F.G.P.

Hydrosulphite Vat: Control. A. Lauterbach. *Melliand's Textilber.*, 1924, **5**, 752 (trans. in *Amer. Dyestuff Rep.*, 1925, **14**, 457-462).

The author demonstrates the value of a test which depends on the oxidation of the hydrosulphite present by a melthylene blue solution and titration of the excess of dye by titanium chloride. To remove disturbing leuco-compounds, sulphites, &c., the measured quantity of vat liquor is diluted with a solution containing formaldehyde and zinc sulphate whereby the hydrosulphite is stabilised and the dye precipitated. Full details are given.—B.C.I.R.A.

Indigo Vat: Effect of Added Substance. *Melliand's Textilber.*, 1926, **7**, 695-696.

A report of a discussion following Haller's lecture. —B.C.I.R.A.

Indigosol O: Application. G. Friedländer. *Melliand's Textilber.*, 1926, **7**, 697-698, 781-783.

Some applications of Indigosol O in dyeing and printing are discussed. —B.C.I.R.A.

Naphthol AS Dyes: Application. *Melliand's Textilber.*, 1926, **7**, 784.

A report of a discussion on Kielbasinski's paper. The following points are dealt with—The action of formaldehyde on Naphthol AS, the affinity of Naphthol AS for basic dyes, the combination of Naphthol AS and vat dyes, the dyeing of artificial silk with Naphthol AS, and the combination of Indigo sols and rapid fast colours. —B.C.I.R.A.

Indigosol Dyes: Application. D. S. Naylor. *Text. Merc.*, 1926, **75**, 42.

The properties of the indigosol dyestuffs and their methods of application, especially in calico printing, are discussed. Eleven

indigosol dyes are listed with short notes on their characteristic behaviour.
—B.C.I.R.A.

Affinity of Cotton, Wool, and Particularly Cellulose Acetate Silk for Azo Compounds (Dyestuffs) containing Sulphonic, Carboxyl, Arsinic, and Stibinic Acid Groups. A. J. Hall and M. I. Aische. *J. Text. Inst.*, **17**, T104-T110.

Dyes: Fastness. S. G. Barker and H. R. Hirst. *J. Text. Inst.*, 1926, **17**, T483-T510.

Dyeing Artificial Silk. See Section 4B.

Dyeing Natural Silk. See Section 4B.

(J)—Printing

Printing with Liquid Artificial Silk. *Text. Amer.*, 1926, **45**, No. 3, p. 45.

The method described is to feed a solution of the materials used for preparing rayon, mixed with suitable dyes, to the pattern rollers for printing cotton. The general effect suggests woven patterns, but it is often far more intricate than is possible on the loom. Where the liquid cellulose lies is 20% stronger than the surrounding parts of the fabric. The finish is said to be permanent and the draping qualities uninjured. The printing is stated to cost a fraction of a penny a yard for large quantities. —F.G.P.

Printing Carpet Yarns. *Text. Colorist*, 1926, **48**, 758-759.

Numerous recipes are given for printing with acid, chrome, alizarin, and vat dyes.
—A.J.H.

Concerning the Printing of Silk. *Text. Colorist.*, 1926, **48**, No. 569, p. 329.

The silk should be thoroughly scoured in a 10% bath of neutral olive-oil soap at 35°-40° C. for 1-1½ hours. It is then mordanted by padding through a bath of stannic chloride at 140° Tw.: 50 l. in 950 l. of water, and leaving the fabric to lie moist for four hours after lifting. After washing the silk is dried on the stenter. Tin-weighted silk does not require this treatment. Almost all classes of dyes are suitable for printing. —F.G.P.

Machine Printing of Silk versus Hand Printing. *Text. Colorist*, 1926, **48**, No. 567, p. 185.

If more than one colour is required block printing is usual, because silk has rather poor absorbent power for the thickening, and there is risk of smearing as the material passes under the rolls of the machine. With care machines may be used. When alizarine reds or pinks are used they may be brightened by the addition of a small quantity of Rhodamine 6G, if the fabric is first padded through Turkey-red oil containing 1·25% fatty acid. —F.G.P.

Preparatory Process for Printing Silk Goods. See Section 4B.

(K)—Finishing

Knit-goods Finishing; Recent Developments. *Text. Rec.*, 1926, **44**, No. 523, 101-105.

Concise descriptions of numerous machines for finishing knitted goods. —A.J.H.

Raised Cloth: Manufacture. *Text. Mfr.*, 1926, **52**, 238-239.

Some general notes on cloth raising dealing with the effects which are produced, the influence of the kind and quality of the material on the character, density, and length of pile, the influence of yarn structure, twist, and ply, the effect of firmness of the fabric in determining the pile produced, and weaves employed in weaving fabrics intended for raising.—B.C.I.R.A.

Water Filtration Plant of a Finishing Company. M. P. Robinson. *Text. Colorist*, 1926, **48**, 763-765.

An illustrated article describing details of the construction of a water purification plant, using a method involving precipitation of aluminium hydroxide and subsequent filtration through sand.—A.J.H.

Proprietary Wetting-out and Finishing Compounds; Criticisms of——. H. Pomeranz. *Meilliand's Textilber.*, 1926, **7**, 841-842.

A scathing criticism of proprietary compounds of "secret" compositions; for example, such as are used in wetting-out and finishing. The author suggests that these compounds should be ignored by the authentic chemist and not subjected to scientific investigation. —B.C.I.R.A.

Fire-proofing. —. Winter. *Chem. Zentr.*, 1926, **ii**, 1599 (from *Z. Ges. Textilind.*, 1926, **29**, 424-426).

A summary of the patent literature relating to the preparation of non-inflammable materials of all kinds.—B.C.I.R.A.

Viscose: Application. E. H. Morse. *Text. World*, 1926, **70**, 1709-1711.

A preliminary article on the use of viscose for producing permanent finishes on textile materials. The article deals chiefly with the manufacture of viscose, but three photographs are reproduced of samples of viscose finished fabric. —B.C.I.R.A.

Cotton-Artificial Silk Union Fabrics: Finishing. W. W. Chase. *Text. World*, 1926, **70**, 2016-2018.

A general article dealing with scouring and bleaching, drying, mercerising, dyeing cotton-viscose, celanese-cotton, lustron-cotton, and three-fibre fabrics, and finishing to preserve lustre or produce a souple finish which is said to reduce lustre and give the fibre the appearance and handle of real silk. —B.C.I.R.A.

Artificial Silk Hosiery: Finishing. *Text. World*, 1926, **70**, 2023.

Some notes on bleaching, boarding, and dyeing artificial silk hosiery, processing

artificial silk in the skein, and finishing artificial silk union fabrics.—B.C.I.R.A.

Artificial Silk Underwear Fabric: Finishing. I. L. Sheldon, Jr. *Text. World*, 1926, **70**, 2028.

The author has obtained the best results in scouring by using a very heavy soap similar to a fulling soap. It removes all traces of oil from the cloth, and no rancid odour is noticeable after finishing. Goods should be scoured before storing in order to prevent tendering due to oxidation of the oil. The scoured fabric must be thoroughly washed in hot water, during which time the kettle is allowed to overflow to carry off the oil. The fabric is then dyed, extracted, examined for stains, and dried at about 100° F. This low temperature is said to produce a fabric which is very soft and lofty. It is subsequently calendered and given a good steaming to improve its softness. The calender rolls should be far enough away from the steam jets so that they will not heat up too much. It is best to run the cloth through the calender with the rolls just warm from the heat picked up from the steam. The cooler the cloth is treated after it comes from the dyeing, the better will be its finish.
—B.C.I.R.A.

Cloth Creasing Machine. Daniel Foxwell and Sons. *Text. Merc.*, 1926, **75**, 41.

The cloth is carried through tension rails and rollers as required, and over a final roller to the top of the machine. It passes over a V-shaped former into the nip rollers, and then to a plaiting-down motion or to a rolling and lapping machine. As an alternative it can be coupled direct to a plaiting or folding machine. A pair of pneumatic guider headstocks controls the position of the selvages which pass between the top of the machine and the nip rollers. The machine carries a measuring arrangement showing the number of yards passed through it. It is said to give 50% more production with one man than with five by hand methods. —B.C.I.R.A.

Three-cylinder Shearing Machine. Thewlis and Co. Ltd. *Text. Merc.*, 1926, **75**, 431.

The machine cuts once on the back of the cloth and twice on the face. The front is arranged with a twitch rail, two wooden rails with a flock fan between, iron tension rail and the necessary rollers to the first cutting cylinder. Before going over the bed of this cylinder the fabric is treated by a revolving brush for the purpose of bringing up the irregularities caused by the long and short fibres. Immediately behind this cutting bed is a draw roller which passes the fabric to the second cutting cylinder, but after leaving the first cutting cylinder the cloth reverses and is sheared on the face by the second cylinder. Another brush is set in front of this cutting part and removes the loose fibres. A second draw roller situated behind the second cutting cylinder propels the cloth to the third cylinder, while it is again treated on the face by a third brush. The cutting cylinders are furnished with patent regulating motions which register up to one-thousandths of an inch on the cut. The machine can be supplied with four cylinders, three of which cut on the face.
—B.C.I.R.A.

(L)—Waterproofing

"Rare Earths" Give Mildew-proof and Repellency. D. G. Woolf. *Text. World*, 1926, **69**, 27.

The so-called "vivatex" process for rendering cotton fabrics mildew-proof and water-repellant is stated to be based on the use of 13 rare earths, of which the best known are thorium, cerium, didymium, and lanthanum. At the Pease Laboratories, Inc., New York, two samples of "vivatex" olive drab were placed in standardised chambers at a temperature of 70° to 72° F., the humidity being maintained at a degree causing slight dampness of the cloth. Both samples were heavily inoculated with a mixed culture of mould spores isolated from mildewed samples from different localities in the middle Atlantic and Eastern States. The results of the regular examination of these samples and the corresponding untreated controls indicated the complete immunity of the former from mildew over a period of 1½ to 2 years.
—L.I.R.A.

Waterproofing Artificial Silk. See Section 5.

Patents

Process for Weighting Silk. A. Pepper. U.S.P. 1,565,390. (From *Text. Colorist*, 1926, **48**, 204).

The usual tin-phosphate is employed with the addition of a pass through a lead acetate bath followed by sodium phosphate.
—F.G.P.

Washable Black Silk Piece Goods and Process for Dyeing them. J. Seyer. U.S.P. 1,565,515 (from *Text. Colorist*, 1926, **48**, 204).

The goods are dyed in a bath of 500 gals. of water containing 30% by weight of fustic and 10% logwood extract, working at the boil for 20 minutes, then adding 25% black iron, 4% blue stone, and 20% acetic acid, and working at the boil for an hour. The fabric is washed and put in another bath of 500 gals. of water containing 30% logwood extract and 50 lb. soap, worked at the boil for an hour, then washing and treating in another 500 gals. of water containing tannic acid at 160° F., and afterwards working in tartar emetic. The goods are soaped twice and then washed and soured. —F.G.P.

Process of Dyeing Silk. J. Seyer. U.S.P. 1,565,516 (from *Text. Colorist*, 1926, **48**, 204).

Piece goods made from tin-weighted yarn are dyed in a bath containing disodium phosphate and a direct dye. —F.G.P.

Cellulose Acetate Union Fabrics: Ornamenting. C. Dreyfus. U.S.P.1,588,951 (from *Chem. Abs.*, 1926, **20**, 2588).

In treating fabrics containing cellulose acetate or similar cellulose derivatives, a mixture of a solvent for the cellulose derivative, for example lactic acid, an inert powder such as infusorial earth, and dextrin or other thickening agent is applied to portions of the fabric. The mixture is allowed to remain in contact with the fabric at a temperature below 125° until at least a part of the cellulose derivative fibres are removable by washing with water and ornamental effects are produced. —B.C.I.R.A.

Fats, Waxes, &c., Removal of; Method of Treating Textile Materials to Facilitate the, by Use of Magnesium Oleate. R. A. Phair. U.S.P.1,598,305 (from *Chemicals* (Dyestuffs No.), 1926, **26**, No. 15, p. 32).

The claim made in this patent is the method of removing the fats and waxes in textile materials which consists in boiling them in alkaline solutions containing magnesium oleate. The function of the magnesium or other fat-soluble oleate is to lower the surface tension of the alkaline liquor to the fats and waxes and thereby to cause their easy removal by the liquor. The magnesium oleate may be used in combination with other soaps or soluble oils. These are added to the alkaline water used in boiling out the fibre to the extent of about 10% of the alkali used.—L.I.R.A.

Lustrous Cotton Fabric: Finishing. C. Mayer. F.P.532,391 (from *Melliand's Textilber.*, 1926, **7**, 802).

The cloth is provided with a thin coating of cuprammonium cellulose or viscose by bringing it into a cold solution of sodium or potassium hydroxide and then into a cuprammonium or alkali thiocarbonate solution. It is run through a dilute acid bath, washed, and dried on heated calenders. The finished fabric is distinguished by an enhanced lustre, not merely in comparison with mercerised cellulose but also against viscose or cuprammonium silk. —B.C.I.R.A.

Method of Dry Dyeing. F.P.591,075 (from *Chemicals* (N.Y.), 1926, **26**, No. 19, p. 16).

A preparation of 25-30% aqueous or alcoholic solution of alkali stearate saturated with lactic acid and coloured with 5% basic dyestuff is heated to 60°-80° C. and mixed with wax to a homogeneous mass, and before it has cooled is moulded into required shapes. Citric or tartaric acids may be used. The design is drawn by means of the dye-wax on to the silk or other material, and batik or printed effects obtained which are fixed by hot irons or calendering. —F.G.P.

Artificial Silk: Fireproofing. F.P.595,286. (from *Text. Merc.*, 1926, **75**, 387).

The material is treated with an almost saturated solution of ammonium sulphate, ammonium carbonate, boric acid, borax and starch, and dried. The excess of superficially-held salts is removed by brushing and the material is finished as usual. It is said to be sufficiently non-inflammable for ordinary purposes. —B.C.I.R.A.

Bleaching Apparatus. F. Kieser. D.R.P. 418,620 (from *Chem. Zentr.*, 1926, **ii**, 646).

The apparatus comprises a vessel in which the goods are packed, and a continuously moving sprinkler pipe which distributes the bleaching liquor uniformly by drops or in a thin stream, so that, without suction or pressure, and without the formation of channels, the liquid saturates the goods and percolates through, when the amount fed into the apparatus is adjusted to equal the amount draining off below the goods. It is claimed that a uniform bleach is obtained for a low consumption of bleach liquor. —B.C.I.R.A.

Viscose Silk Dyeing. E. O. Sanner. D.R.P. 428,263 (from *Chem. Zentr.*, 1926, **ii**, 648).

Regenerated cellulose such as viscose silk, or mixed fabrics containing viscose, are boiled for half an hour in a solution of 6% of Marseilles soap and 5% of an alcoholic soap solution obtained by alcoholic saponification of vegetable fats in the presence of small quantities of soda, centrifuged, and dyed in a boiling bath containing 6% of the alcoholic soap solution. To the cooled bath 2-3% of 85% formic acid is added and the material is subsequently centrifuged. The dried goods have a silky feel and lustre. —B.C.I.R.A.

Higher Alcohol Mercerising Assistant: Application. Chem. Fabr. Milch A.-G. D.R.P.430,085 (from *Chem. Zentr.*, 1926, **ii**, 1214).

Higher alcohols or ketones are added to the mercerising bath. The use of butyl or amyl alcohol, cyclohexanol, &c., rendered soluble with alcohol, is claimed to reduce the mercerising period to one-third and to give a fabric with higher lustre. —B.C.I.R.A.

Fast Dyeings on Vegetable Fibre. Chem. Fabr. Griesheim-Elektron, Frankfort-on-Main. E.P.235,169 (from *J. Soc. Dyers and Col.*, 1926, **42**, 295).

Clear shades, fast to kier boiling, are obtained by combining a β-naphthalide of 2:3 hydroxy-naphtholic acid with an unsulphonated diazo-compound containing substituents, of which one must be chlorine in the 2:5 positions to the diazo-group, e.g., diazotised 4-chloro-*o*-toluidine, 4-chloro-*m*-anisidine, 2 : 5-dichloro-aniline, &c. After impregnation of the cotton in the usual way with a solution (20 g. per litre) of 2 : 3-hydroxynaphthoic acid-naphthalide, they are printed with the following paste—31·4 g. of 4-chloro-*m*-anisidine are diazotised and sodium acetate

added as usual, and the liquid is thickened with 31·4 g. of neutral starch-tragacanth paste. The bluish-red goods are rinsed, soaped, and dried. —L.I.R.A.

Cellulose Acetate Silk Dyeing. British Celanese Ltd., London, and G. H. Ellis, Spondon. E.P.255,962.

Yarns, fabrics, &c., made with or containing cellulose acetate, may be dyed by processes involving the oxidation of aniline or other amino bodies. The amino body is applied to the goods from aqueous solution in suspension, thereafter, preferably after rinsing, impregnating with suitable oxidising agents, and afterwards, without rinsing but preferably after drying, subjecting the goods to ageing in warm, moist air, or in steam, or in air and steam. The amino bodies may be applied in the form of solutions of their water-soluble salts, or in the form of their solubilised or colloidally dispersed modifications. As oxidising agents, chlorates, hypochlorites, and bichromates may be employed, if desired, with the addition of catalysts such as salts of vanadium, iron or copper, and in the presence of salts such as glauber salt or ammonium, barium, calcium, or magnesium chloride; when acid salts are used it is preferred to add acetates to prevent tendering of the fibre. Examples are given, with the shades which can be obtained. —B.C.I.R.A.

Cellulose Acetate Silk Dyeing. Soc. Chemical Industry in Basle, Basle, Switzerland. E.P.256,205.

Monoazo dyes which dye cellulose acetate in fast yellow shades are made by coupling 1-(2′chlor)-phenyl-3-methyl-5-pyrazolone with unsulphonated diazo compounds, diazotised aniline being used in an example. For dyeing cellulose acetate the dyestuff is ground in the form of its moist press cake with a protective colloid, e.g., sulphite cellulose liquor. —B.C.I.R.A.

Cellulose Acetate Silk Union Fabrics: Printing. Soc. Anon. des Etablissements Petitdidier, St. Denis, Seine, France. E.P.256,238.

Fabrics containing cellulose acetate and cotton or viscose silk are printed by employing the following operations—(1) Printing in the usual manner with a colouring matter such as one having an anthraquinone basis, certain acid dyestuffs such as citronine, or basic colouring matters mordanted with acetanol. (2) The printed fabric is steamed to fix the colouring matter on the fibres of cellulose acetate. (3) The fabric is rinsed, whereby a portion of the colouring matter is removed from the cotton or viscose silk. (4) The fabric is optionally steeped in a dilute solution of hydrosulphite in order to remove all colour from the cotton or viscose silk. The fabric may be finally dyed with a colouring matter which has affinity for the cotton without appreciably affecting the colour of the cellulose acetate portion. —B.C.I.R.A.

Cloth Finishing Machine. F. Wolf, Vienna. E.P.256,244.

A lustrous fabric, as a substitute for glacé thread fabric, is woven from raw yarn and dyed in the piece, or made of dyed yarn, is impregnated with a finishing substance, and is then treated on one or both sides while moist and stretched by quickly-moving brushes. Fabric from a roll passes over tensioning-rollers to a trough containing the finishing liquid, and thence to rapidly-revolving brushes, weighted rollers being arranged between each two brushes. Heated drums or pairs of drums may be arranged between consecutive brushes. The finished fabric is wound on a beam after being dried in the usual manner after leaving the last brush. The finishing material may be mixed with the dye. —B.C.I.R.A.

Yarn Beam Drying Mechanism. W. P. Hornbuckle and R. F. Craig, Stanley, N. Carolina. E.P.256,454.

The yarn, &c., beams of dyeing machines are dried by being held by screw-operated caps against the heads of the valve-controlled branches of a pipe to which air is supplied from a heater by a blower. The hot air is forced into the interior of the beams and laterally through the yarn wound on them. The caps are connected to the screws by balls and plates. —B.C.I.R.A.

Cloth Plaiting Machine Compensating Motion. J. Greenfield, Elton, Bury. E.P.256,559.

Vegetable Oil Coating Composition: Preservation. G. E. Scharff and Nobel's Explosives Co., Ltd., Stevenston, Ayrshire. E.P.256,654.

Rancidity in vegetable oils used in compositions for coating fabric, paper, &c., is prevented by adding to the oil and other ingredients, such as nitrocellulose, camphor, and pigments or fillers, a small quantity of a metallic sulphide, preferably of the second group in wet analysis, for example, antimony, arsenic, zinc, or lead. —B.C.I.R.A.

Figured Gauze Fabrics: Finishing. H. H. C. Wilcock, Glasgow. E.P.256,666.

To produce figured gauze fabrics, a leno or other fabric is woven in a one-shuttle loom with a multiple filament weft comprising material which is non-susceptible and material which is susceptible to the action of a solvent or agent in a subsequent carbonising process, for example, cotton and silk, wool, or Celanese. Thus, one fine cotton thread and one coarse wool thread are wound on the same pirn so as to be introduced at the same pick but not twisted together. A coloured pattern is printed on the fabric and the fabric is carbonised at the unprinted or ground part

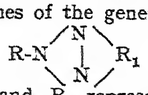
as by treatment with caustic soda with the aid of a roller engraved with the ground part. The susceptible material (wool, &c.) is destroyed in the ground part, leaving a comparatively heavy printed portion on a gauze or net ground. The fabric resembles a "Madras" fabric. —B.C.I.R.A.

Polishing Cloths: Preparation. J. D. Williams, Meliden, Flintshire. E.P. 256,788.

A polishing cloth is prepared by saturating a fabric, preferably flannelette, with a hot solution of borax with or without the addition of glutinous matter, such as glue, gelatin, or isinglass, compressing the fabric to express excess of solution therefrom, and passing the fabric with or without previous drying, through a solution, preferably a 10% solution of aluminium sulphate or alum, any excess of solution being removed and the fabric dried. The solution of borax, which concontains 2 lb. of borax per gallon of water is preferably kept at a temperature just below boiling point. Castile Soap may be added to the borax solution instead of the glutinous matter. —B.C.I.R.A.

Developed Azo Dyes. Lakes: Application. A. G. Bloxam, London (for Chem. Fabr. Griesheim-Elektron). E.P.256,808/9.

(1) Azo dyes are produced either in substance or on the fibre, by coupling diazotised monoamino bases of the diphenyl series with 2:3-oxy-naphthoic arylamides; the 2:3-oxy-naphthoyl-aniline, -chloranilines-toluidines, -anisidines, and others are mentioned. According to examples, red shades are produced on cotton yarn from the following pairs of components—4-amino-4′-chlor-diphenyl and 2:3 oxy-naphthoyl-*m*-chloraniline, 2-amino-diphenyl and 2:3-oxynapththoyl-5-chlor-2-anisidine and others. A table is given showing the shades obtainable with the aid of a number of other components. Specifications 6379/12 and 17279/13 are referred to. (2) Azo dyes are produced in substance or on the fibre, by coupling with 2:3-oxy-naphthoic arylides the diazo compounds from unsulphonated amino substituted pseudo-azimines of the general formula—



in which R and R_1 represent the same or different aryl nuclei which, in addition to one or two amino groups may contain further substituents. According to examples, (1) dizaotised 2-(2′-amino-4′-chlorphenyl)-psuedo-azimino-α-β-napthalene is coupled in substance with 2:3 oxynaphthol-2-anisidine; the product yields scarlet lakes; (2) cotton is dyed red, bluish-red, or garnet shades by impregnating with 2:3-oxynaphthoyl-aniline or β-naphthoyl-amine and developing with diazotised 2-(3′-amino-4′-methyl-phenyl)- or 2-(4′-amino-phenyl)- or 2-(2′-amino-4′-chlor-phenyl)-pseudo-azimino-α-β-naphthalene. A table is given showing the shades obtainable with a number of other pairs of components. —B.C.I.R.A.

Hank Dyeing Machines. P. F. Höltzing, Hamburg. E.P.256,854.

Hanks of yarn are carried upon a framework between upper and lower perforated plates in a chamber wherein the dyeing liquid is circulated alternately in opposite directions by a propeller in an auxiliary chamber. An adjustable flap valve is situated in the lower circulation passage. —B.C.I.R.A.

Adjustable Multiple Roll Calender. Calico Printers' Association and F. Farnworth, Manchester. E.P.257,058.

In machines for producing a finish effect on fabrics of the kind having positively-driven felt-covered rollers intermediate between heated polished metal rollers rotated by surface contact, the rollers are arranged in bearings capable of vertical and horizontal adjustment to bring different rollers into contact with one another to vary the effect on the fabric, the polished roller is provided with means whereby it is given a jigging endwise movement, and the rollers are arranged so that both sides of the fabric are treated by a single passage through the machine. Finishing material such as oil, wax, &c., may be applied in known manner by one or both of the polishing rollers in contact with the felt-covered rollers. Means may be provided for indicating the pressure between the felt-covered rollers and the polished rollers.—B.C.I.R.A.

Drying Machine. Tomlinsons (Rochdale) Ltd., and G. C. Tomlinson, Rochdale. E.P.257,106.

Articles to be dried are charged into perforated drums which are rotatably supported on trucks adapted to be moved either continuously or intermittently through the drying chamber in counter-current to heated air, the chamber having compartments with corresponding side heating compartments through which the air is continuously circulated by fans during its passage to the discharge fan. The drums are rotated either continuously or intermittently through toothed wheels engaging with an endless travelling chain. In a modification, the drums are arranged with their axes longitudinally of the drying-chamber and are rotated through worm-gearing from an endless travelling chain. —B.C.I.R.A.

Dyeing Machine. P. F. Höltzing, Hamburg. E.P.257,160.

The vertical shaft of the circulating propeller is coupled to and driven directly by the vertical shaft of an electric motor. The motor may be reversible or otherwise, and in the latter case the blades of the propeller are adjustable to produce alternate forward and reverse flow of liquid. —B.C.I.R.A.

Cotton Waste, Rags: Degreasing. Naamlooze Vennootschap Algemeene Chemische Produktenhandel, Paulownastraat, The Hague, and W. A. Meyer, Hersfeld, Germany. E.P.257,192.

In a process for the removal of grease, &c., from such materials as cotton waste, rags, and cloth, by treating under continuous movement with an organic solvent, residual solvent is removed from the material by a current of air or gas, and solvent vapour is recovered from the gaseous mixture by absorption in a liquid such as creosote oil or adsorption by a body, such as active carbon, having an extensive surface. The material may be carried through one or more gas-tight chambers on perforated belts and be sprayed with benzene, benzol, &c., under pressure, or it may be passed through a bath of solvent in which it is lightly beaten by rods. Alternatively, the counter-current principle of applying the solvent may be used. The bulk of the solvent is removed by means of rollers and the material is then conveyed to a gas-tight chamber supplied with heated air, nitrogen or carbon dioxide, whence the mixture of gas and solvent is removed by means of an exhauster and led into the absorbing liquid or through the active carbon, &c. The air may be finally cooled to a temperature below 0° C. —B.C.I.R.A.

Cellulose Ester Solvents. I.G. Farbenindustrie A.-G., Fränkfort-on-Main. E.P. 257,258.

Halogen alkyl esters of mono- and polybasic carboxylic acids, including carbonic acid, or their substitution products, having a boiling point above 150° C., are employed as solvents for organic materials such as cellulose derivatives, resins, waxes, varnishes, and dyestuffs. Suitable esters are the dichlorethyl ester of carbonic acid, propionic acid chlorethyl ester, phthalic acid dichlorethyl ester, and the corresponding chlor- and brom-propyl esters. Esters of a boiling point above 225° C. may be used as plastifiers for cellulose nitrate and acetate, or mixtures of these with each other or with resins, cellulose ethers, &c. Some examples are given. —B.C.I.R.A.

Anthraquinone Dyestuffs Possessing Affinity for Acetyl Silk. British Dyestuffs Corporation Ltd., Manchester, W. H. Perkin, and C. Hollins, Blackley. E.P.257,353. (*Chem. Age*, 1926, **15**, 330).

A derivative containing a primary amine group is condensed with an active derivative—α-amino-anthraquinone, α-diamino-anthraquinone and simple derivatives such as diamino-anthrarufin and diamino-chrysazin in the presence of calcium chloride or iodine as the condensing agent. The first component may be α- or β-amino-anthraquinone or derivatives as 1-amino-2-methyl-anthraquinone. The products are not vat dyestuffs but have good affinity for cellulose acetate when dyed from suspension in water. They are probably anthraquinonyl-iminoanthrones. —F.G.P.

Felt-covered Roller. F. Reddaway, Pendleton, Manchester. E.P.257,432.

Rollers for use in printing, padding, squeezing and calendering fabrics are covered with one or more helically-wound layers of a built-up yarn composed of an inextensible core, for example of flax, around which are wound two or more woollen yarns, the roller then being felted or milled. When a number of layers of yarn are employed the surface of the roller may be felted after the application of each layer. The ends of the covering are held in place by collars having under-cut edges, the ends of the yarns being passed through grooves in the collars and in the roller body, and secured by knotting or otherwise. The yarn may be wound directly on to the body of the roller or on to a rubber sleeve on the roller. In some cases, the yarn is wound on to a core or shell, which is subsequently applied to the roller. —B.C.I.R.A.

Scouring Apparatus. D. McKellar, Glasgow, and J. MacGregor, Silvertown, London. E.P.257,491.

A process for dewaxing or degreasing fabrics consists in passing the fabric arranged in folded piles in series on a conveyor slowly through a tank of solvent. The tank is provided with a sliding door and a conveyor movable by a chain and sprocket and handle. A pile of fabric is delivered adjacent to the door and transferred to the conveyor each time a pile at the other end of the conveyor has been unfolded by rollers and passed to a washing tank which may be of the kind described in Specification 178,206. One or more inspection windows are provided at the delivery end of the tank. —B.C.I.R.A.

Cellulose Acetate Silk: Dyeing. British Dyestuffs Corporation, R. S. Horsfall, L. G. Lawrie, J. A. R. Henderson, and J. Hill, Blackley, Manchester. E.P. 257,654.

Masses of fibres composed of cellulose acetate are dyed with ordinary acid and direct dyestuffs in which the sulphonic acid group or groups in the coupling components have been converted into sulphonamide groups. The dyestuffs may be made by using components already containing the sulphonamide groups, or dyestuffs in which the coupling components contain sulphonic acid groups which may be converted into sulphonamide groups by treating with phosphorous pentachloride and ammonia. In examples, red or orange shades are obtained by using the dyestuffs prepared by coupling diazobenzene with 1-naphthol-3:8-disulphonamide, and with 1:8-naphthasultam. —B.C.I.R.A.

Loom Picking Motion. E. Hollingworth, Dobcross. E.P.257,700.

In a spring picking motion in which the spring connecting the picking levers is

extended by the reciprocation of a longitudinal rod, the rod is actuated by a crank-lever linked to a crank on a side shaft. The side shaft is driven at half-speed from the main crank shaft by gearing. The longitudinal rod, which is adjustably connected to the crank lever, actuates levers, one of which on oscillation shifts the picking lever to extend the spring until a catch engages a pin. On return movement, an adjustable pin on the lever raises the catch to allow picking to take place. The spring is connected to the levers by flexible connections which pass round rolls on the frame and the levers respectively. At the end of the picking motion the roll on the lever moves downwards relatively to the other roll so that the flexible connection is taken up slightly to cushion the picking lever. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Washing—

256,635. E. C. Duhamel and Compagnie Générale des Industries Textiles. Processes for washing and cleaning wool.

Drying—

257,706. S. Walker & Sons Ltd., and G. E. Walker. Drying artificial silk in long lengths.

Carbonising—

257,153. W. M. R. Jahr. Drying and carbonising of textile fabrics.

Finishing—

256,087. S. Colomer. Proofing fabrics against chemicals.

256,479. A. Pepper. Loading silk.

5—LAUNDERING AND DRY CLEANING

Laundry Research and the Textile Industry. G. H. Johnson. *Exp. Sta. Rec.*, 1926, **54**, 393 (from *Text. World*, 1924, **66**, 31, 32, and 55).

The scope of the research on textiles carried on by the Laundry Owners' National Association at Mellon Institute, and at the American Institute Laundry, Joliet, Ill., is outlined, special consideration being given to table linen, shirting, knit underwear, and hosiery. —L.I.R.A.

Artificial Silk: Dry-cleaning. *Nat. Assoc. Cotton Mfrs.*, Bull No. 74, 1926.

Samples of cloth made with a cotton warp and Tubize, viscose or Celanese weft were dry-cleaned at a commercial dry-cleaning works. The width, count, weight, and strength of each sample were determined before dry-cleaning, and after 1, 2, and 3 treatments. The process consisted in dipping the fabrics in a solution of 20% ammonia, soap, and naphtha. The soap and naphtha was a solution made from oleic acid and naphtha, and the specification for the solvent is recorded. After treatment the fabrics were deodorised by exposure to air at a temperature of 130°-150°. It was concluded from the data obtained that dry-cleaning, if properly carried out, has no appreciable effect on any of the common synthetic fibres. —B.C.I.R.A.

Textile Fabric: Laundering and Oxygenol: Application. F. H. Thies. *Meilliand's Textilber.*, 1926, **7**, 863-868.

Data on the effect on strength and extension of repeated laundering with a chlorine bleach, soda boil, and chlorine bleach, soap and soda boil, and chlorine or perborate bleach, soap, soda, and waterglass boil and perborate or Oxygenol bleach are provided, and the Oxygenol combination process is shown to be both efficient and economical for power laundries. Oxygenol is a perborate compound but differs from Persil and is not suitable for household use. —B.C.I.R.A.

Artificial Silk Knitted Fabrics: Washing. *Text. World*, 1926, **69**, 3669.

The following tentative recommendations for washing artificial silk knitted underwear, based on washing experiments in three types of home laundry machine, are proposed—Use only good quality neutral soap, preferably in powder or flake form, and wash in warm water, keeping the temperature below 140° F. In most cases, 10 mins. will be long enough for washing. Avoid overloading machines and, when washing by hand, use rubber gloves and souse the goods until soap permeates the whole fabric. Do not pull or stretch the fabric in this condition. Rinse in water of approximately the same temperature as the washing water to avoid sharp temperature contrasts. Five or six minutes should be sufficient. Do not use roller wringers for removing excess of water. The centrifugal type is satisfactory, otherwise squeeze out excess water by hand but do not twist. Dry by laying garments on a flat surface and at ordinary room temperature. Do not hang, and keep away from excess heat. Use a medium hot iron. —B.C.I.R.A.

Artificial Silk: Laundering and Waterproofing. *Text. Merc.*, 1926, **75**, 556.

A number of attempts have been made to preserve the strength of the fibre during dyeing, finishing, and laundering by waterproofing it. One process consists in treating the yarn with formaldehyde and lactic acid; the yarn becomes more waterproof, hard, and loses some of its affinity for dyestuffs. Viscose may be treated with aluminium acetate during the desulphurising process. Artificial silk may be safely handled in laundries if it is given the same care and consideration as real silk. —B.C.I.R.A.

PATENTS

Cellulose Ester Solvent. I.G. Farbenindustrie A.-G., Frankfort-on-Main, Germany. E.P.256,229.

Solutions of organic compounds such as cellulose esters or ethers, natural or artificial resins, waxes, lacs, perfumes, dyestuffs, fats, and oils, &c., for use in varnishes, cleaning agents, polishes, &c., are made by the aid of di-ethers of ethylene glycol having the general formula *R*-glycol-*R'* in which *R* represents alkyl, aryl, or aralkyl, and *R'* alkyl or aryl radicals, alone or with other stipulated solvents. Plasticisers may be added to some of the solutions. The use of di-alkyl ethers of ethylene glycol as solvents for cellulose esters is disclaimed. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Laundering—

256,000. A. H. Taylor. Drying rack for articles of clothing.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Water Vapour Mists: Viscosity. G. Mokrzycki. *J. Phys. et Radium*, 1926, **7**, 188-192.

A method of measuring the viscosity of air charged with water vapour is described. Essentially the apparatus consists of a Woolf's bottle provided with a capillary, closed by a drying tube, an exhaust tube and manometer, and an inlet tube through which water can be introduced by gravity action. In the measurement, a definite volume of air is expelled through the capillary in a measured time interval by manipulating the water level. A mist is formed by compressing the air in the bottle, ionising and suddenly releasing the pressure. The time for the expulsion of the same volume of air and mist through the capillary under the same conditions as before is taken, and the weight of water in that volume obtained by weighing the drying tube. The diameter of the droplets is measured optically. For diameters between 5×10^{-5} and 10^{-3} cm. and for weights of mist, Δ, between $1{\cdot}5 \times 10^{-6}$ and $1{\cdot}5 \times 10^{-5}$ g/cm.^{3} the experimental results, reduced to 0° C., may be represented by the formula $\mu_{mist} = \mu_{air} + 1{\cdot}59\,\Delta$. —B.C.I.R.A.

Ethylene Glycol: Physical Properties. C. A. Taylor and W. H. Rinkenbach. *J. Ind. Eng. Chem.*, 1926, **18**, 676-678.

A summary of available data. —B.C.I.R.A.

Streaky Dyed Artificial Silk: Causes. H. G. Dahlenvord. *Melliand's Textilber.*, 1925, **6**, 739-742, 823-824.

Streaky dyeing in artificial silk is discussed and some experiments to determine its causes are described. In experiments to determine the possible effect of degree of dispersion, conditioned chiefly by the sodium hydroxide, an alkali cellulose was aged for 36 and for 72 hours and the two samples were subsequently spun and dyed under the same conditions. Mixtures of Chicago Blue 6B and Neutral Gray and of Pluto Brown BN, Pluto Orange N, and Chrysophenin were used for the dye tests and the shades obtained were expressed in terms of the Ostwald system. Contrary to expectation the experiments led to negative results. Subsequently, the effect of ripeness of the viscose solution was studied. Samples were spun and dyed from viscose immediately after solution and after 24, 48, 72, and 94 hours. The viscosity and ripeness at each stage was determined. The blue-dyed samples showed great variation in intensity, the fresh viscose having the darkest colour and the intensity diminishing with increased ripeness. The brown colour showed not only change of tone but also changes in black and white content. The affinity for dyes is influenced in a similar way by diluting the precipitating bath and thus retarding the rate of coagulation of viscose solutions of equal ripeness. The experiments thus confirmed the author's supposition that the rate of coagulation influences the crystallite structure of the filaments in such a way that the spaces between the crystallites are larger when coagulation is slow than when it is rapid; thus, fresh viscose solutions, which coagulate only slowly, give darker colours because the larger spaces between the micellæ enable larger dyestuff particles to be absorbed. Uneven absorption of dyes is thus traced to differences in the crystallite structure of the artificial silk. In a large number of experiments low affinity for the dyes used was found to be associated with low extensibility and of a number of viscose silks of different origin which were dyed together in a single bath, those which showed the most intense colour had the highest extensibility. Factors other than ripeness of the viscose which might lead to a change in the ultimate structure of the artificial silk through variation in the amount of unesterified cellulose in the viscose are, too high a temperature in the sulphiding process leading to unequally sulphided products, and uneven mercerisation of the cellulose. —B.C.I.R.A.

Oxycellulose: Determination. E. Ristenpart. *Melliand's Textilber.*, 1925, **6**, 830.

A new method of determining oxycellulose in dyed cotton material is described as follows—0·5 g. of the cotton to be tested is boiled for 1 minute with 5 c.c. of Fehling's solution, washed and allowed to stand with 5 c.c. of nitric acid of S.G. 1·2 for 10 minutes. The nitric acid solution is evaporated to dryness and ignited to destroy the fibre and to convert the nitrate

into oxide. The residue is treated with potassium bisulphate solution sufficient to convert the copper oxide into ice-blue copper sulphate. The remaining residue is dissolved in 5 c.c. of water on the water bath and concentrated ammonia added drop by drop until the deep blue colouration is developed. The colour shade as determined by the Hahn colorimeter or the Pulfrich photometer forms a standard of copper and oxycellulose amounts. From tests described the author finds that Fehling's solution is reduced in increasing degree by bleached cotton, by dyed cotton (both oxycellulose-free), by dyed cotton stripped with Rongalite and by oxycellulose. Thus the mere fact of reduction does not necessarily indicate the presence of oxycellulose; the degree of reduction must be determined by the aid of a blank experiment with an oxycellulose-free sample of the same dyeing. —B.C.I.R.A.

Cotton Hair, Yarn, and Cloth: Strength. A. Rosenzweig and H. Sommer. *Melliand's Textilber.*, 1925, **6**, 854-855, and 891-895.

Rosenzweig affirms that Spohr's figures for sewing cotton confirm his contentions, and the controversy is closed with a reply from Sommer. —B.C.I.R.A.

Wetting Agents: The Testing of——. J. Auerbach. *Melliand's Textilber.*, 1926, **7**, 681-685.

The author briefly reviews previous work on the wetting power of various agents and describes experiments in which a quantitative measure of wetting power was obtained by observing the time taken for a piece of raw woollen cloth 4 cm. square to sink in the solution. The results are given in tabular and graphical form. Experiments were made at temperatures of 16°, 30° C., and 80° C. with concentrations of 5, 3, 2 gms. and 1 gm. per litre of the various agents. Shortest sinking times were observed with Oranite, Nekal A (powder), and Neomerpin N. —L.I.R.A.

Wetting Agents; The Testing of——. II. W. Kind and J. Auerbach. *Melliand's Textilber.*, 1926, **7**, 775-780.

A continuation of a previous article. The wetting power of solution of various agents was compared by the drop-number method, and the results obtained are given in tabular and graphical form. The influence of the various wetting agents on the penetration of dyes into spools of yarn immersed in the solutions was also investigated; the different effects of various agents is strikingly shown in an illustration of cross-sections of the dyed spools. —L.I.R.A.

Wetting Agents; Testing of——. W. Seck and H. Lachmann. *Melliand's Textilber.*, 1926, **7**, 851-854.

The authors criticise previous attempts which have been made to obtain a quantitative measure of the wetting power of a solution, and describe a method they have themselves used. A piece of loom-state cloth (Rohnessel), 5 cm.×6 cm. weighing about ½ gram, is dipped into the solution for exactly 10 seconds, and then withdrawn and drained for exactly 50 seconds. The weight of liquid taken up by the cloth under these conditions is determined, the material being placed in a closed vessel when being weighed. The wetting power of solutions is thus compared by carrying out this determination under strictly comparable conditions. Using this method with solutions of various wetting agents at concentrations of 2, 4, and 6 gms. per litre, it was found that products prepared from alkylated napththalene sulphonic acids (Nekal B.A.S.F. and Oranite, Milch) gave solutions with the greatest wetting power. Next in order came Avivan (a preparation of Turkey Red Oil with a fat solvent), and then followed various other Turkey Red Oil preparations. Tetracarnite did not behave as a wetting agent under this test; its value clearly lies in other directions. —L.I.R.A.

Wetting Agents: Testing. *Melliand's Textilber.*, 1925, **6**, 866-867.

A litre of water or water containing dyestuff is placed in each of three similar glass cylinders or beakers and 10 c.c. of the wetting agents to be compared added to each. The same weights (2, 3, or 4 grms.) of a fibre which is hard to wet, e.g., sheep's wool, are laid on the surface of the diluted wetting agents. With a good wetting agent the wool sinks after a few minutes. More accurate results are obtained by using pieces of wool or cotton material, free from finishing agents, which have been impregnated with a 1 : 20 solution of mineral oil in light petroleum. After evaporating the light petroleum sections of cloth 4×4 cm. are carefully laid horizontally on the surface of the diluted wetting agents under test and the time of sinking noted. —B.C.I.R.A.

Wetting Agents: Testing. W. Herbig and H. Seyferth. *Chem. Zentr.*, 1926, ii, 132 and 11 (from *Z. Deutsch Öl u. Fettind*, 1926, **45**, 751-754, and **46**, 81-84).

(1) Wetting power is largely dependent on the concentration of the wetting agent. The wetting powers of five commercial products in relation to concentration over a range of 0-20 grams per litre are compared graphically. The wetting-power is inversely proportional to the concentration, up to a limit. It is shown that surface tension is not an accurate measure of wetting power.

(2) The authors describe with many diagrams experiments to determine a relationship between the wetting power of liquids and their level of rise or rate of rise. The results were negative. Further, stalagmometer comparisons afforded no evidence of a direct connection between surface tension and wetting power.—B.C.I.R.A.

Cloth: Testing. A. Foulon. *Melliand's Textilber.*, 1926, **7**, 523-524.

A general discussion of the essential factors to be considered in valuing a cloth. —B.C.I.R.A.

Yarn: Regain Determination. —. Gräbner. *Melliand's Textilber.*, 1925, **6**, 855-856.

The method prescribed by the Verein deutsche Wollkämmer und Kammgarnspinner for determining the moisture content of conditioned yarn sent out for sale, and therefrom the right commerical weight of the consignment is described. The test, which involves among other things the weighing in the conditioned state of a measured length of yarn, gives also the count of the yarn. The limit percentage errors allowed in commercial transactions in count numbers of various worsted yarns are enumerated. —B.C.I.R.A.

Diastatic Steeping Agents: Testing. *Melliand's Textilber.*, 1925, **6**, 866.

For comparing the diastatic power of two enzyme preparations, a smooth 5 or 10 per cent. paste is prepared from pure potato starch and water, divided into two parts and brought to 63-65°. A weighed quantity of one or other diastase preparation, dissolved in water if necessary, is added to each with stirring and the relative rates of liquefaction of the starch observed. The diastase preparation which liquefies the starch to the greater extent in the time is the stronger. The experiment is repeated with varying quantities of the weaker preparation until the rate of liquefaction is the same as that found for the stronger product. The ratio of the quantities of the diastase preparations required in each case gives approximately the relative values of the two preparations as desizing agents. The method can be made quantitative by stopping the diastatic action after 15 minutes, cooling rapidly to room temperature and measuring the degree of fluidity in a viscometer. By plotting viscosity readings against diastatic concentrations a curve is obtained which serves as a standard of measurement. —B.C.I.R.A.

Viscose Yarns: Physical Properties. *Nat. Assoc. Cotton Mfrs.* (U.S.A.), Bull No. 77, 1926.

The results of physical tests on a number of well-known brands of viscose yarns are tabulated. All the yarns were submitted as 150 denier. There is suprisingly little difference in the strength of the different yarns, the principal differences coming in the irregularity as shown by the variation of strength and in the denier. The number of filaments or the denier per filament may be considered one of the factors which will indicate the flexibility and covering power of the yarn; the finer the denier per filament, the larger the number of filaments, giving a softer yarn with more covering power. The results also give a very good indication of the amount of moisture that the yarn will contain under average conditions. —B.C.I.R.A.

Carded Cotton Warp Yarn: Strength. *Nat. Assoc. Cotton Mfrs.* (U.S.A.), Bull. No. 78, 1926.

The results of breaking strength tests on warp yarns of counts from 10 to 70, made from staples of $\frac{7}{8}$ in., 1 in., $1\frac{1}{8}$ in., $1\frac{1}{4}$ in., and $1\frac{3}{8}$ in. are given. The tests were made on a 120 yard skein conditioned in an atmosphere of 70% relative humidity. —B.C.I.R.A.

Viscose Yarns: Strength. *Nat. Assoc. Cotton Mfrs.* (U.S.A.), Bull. No. 78, 1926.

The results of tests for breaking load and elongation of a number of 100 and 300 denier viscose yarns are given. There was considerable variation in the number of filaments making up the yarns, the number used to make the 300 denier varied from 36 to 50. This variation may be responsible for barred effects in fabrics woven with all-rayon weft. —B.C.I.R.A.

New Test for [Viscose and Cuprammonium] Silks. *Text. Rec.*, 1926, No. 524, p. 67.

A test devised by the U.S. Bureau of Standards is based on the fact that viscose silk heated with an acid yields hydrogen sulphide, whereas cuprammonium silk does not. —A.J.H.

Fabric Strength Test Strips: Preparation. T. Woodhouse and G. Dalgity, Jun. *Text. Mfr.*, 1925, **51**, 156-157, 267-268, and 1926, **52**, 123-124 and 259-261.

Some tests on the apparent and actual tensile strength of fabrics are discussed. The results indicate that there is a considerable difference in many instances between the breaking load as recorded from the tests of ordinarily prepared strips and the actual breaking load which may be obtained when the threads or picks under test are kept intact and in position until rupture is complete. The actual breaking load can only be registered when all the threads or all the picks are gripped by both sets of jaws by a grab grip or by making the strips a definite width at each end and leaving extra double threads loose at each side of the gripped parts but intact in the cloth, or by a similar method which keeps all threads in their relative positions. —B.C.I.R.A.

"Shiners" in Rayon-filled Fabric. J. Chittick. *Text. Amer.*, 1926, **45**, No. 3, p. 37.

Shiny streaks in the shoot are not single threads, as a rule, but bands of brighter yarn extending for a few inches. They rarely extend from side to side of the piece and are often coincident with the amount of thread on one bobbin. When examined under a microscope they are seen to be under greater tension than the rest of the weft. The extent of shiners is greater when two bobbins are used than with

one. It is considered that they are the result of undue stretching of the thread when it is being wound on the bobbin, because the yarn has not been allowed to get thoroughly evened up as regards humidity. When the skeins are opened out on the parting sticks, a slight touch of paraffin is sometimes used to help the separation of the threads and so assist the evening up. The winding, warping, and other rooms should be kept at even temperature and moisture, and all tensions carefully adjusted. —F.G.P.

Defects Associated with the Reed. J. Chittick. *Text. Amer.*, 1926, **45**, No. 4, p. 13.

Discusses reeds generally. With regard to silk dyed in the yarn which does not go through a wet finishing process, cloths sometimes have a reedy appearance owing to the dents being rather widely spaced and the threads not filling up afterwards. European silk reeds generally have the dents twice as broad as the wires, it is said, but in America both are equal. The European practice causes less trouble with knots, but if the reed has very fine wires there is a tendency when the loom is working fast for the reed to be beaten sideways. If a reed on a silk loom becomes damaged the warp should be cut out and re-reeded for a streak spoils the cloth. Very fine dented reeds add greatly to the difficulties of weaving. The difference in output between 60/4 and 120/2 is placed at 30%. —F.G.P.

Testing Silk for Tin Weighting. *Text. Colorist*, 1926, **48**, No. 569, p. 330.

If, when the silk is boiled with a small amount of alizarine orange, it takes on a dull bluish-pink colour, it is unweighted; a bright orange shade proves the presence of tin. Logwood and acetic acid when boiled with silk give a violet shade when tin is there, a red when it is absent. —F.G.P.

Silk and its Testing. J. O. Thompson. *Text. Colorist*, 1926, **48**, No. 568, p. 241.

Silk responds rapidly to change of humidity in the air of the laboratory. Tests have shown an elongation of 15-22% when the humidity has been raised from 40-70%. The breaking length of silk is said to be 22 miles, about quarter that of steel. The strength and cleanness of silk should not be averaged as it is the irregularities that give rise to trouble. The defects of silk and their grading are discussed. —F.G.P.

Re-worked Cotton: Identification. W. Sieber. *Melliand's Textilber.*, 1926, **7**, 677.

Knitted cotton rags form the bulk of the material used for the production of re-worked cotton yarns (called by the author artificial cotton) and in breaking down the material to single fibres a part retains the thread form. The method of identification described is based on this behaviour. If a thread of re-worked cotton is untwisted, a number of small pieces are found which have retained their spun form; often they can be seen on the surface of the finished yarn. Generally they are visible to the naked eye and always with a thread counter. Re-worked cotton can be similarly detected in yarns spun from a mixture of new and re-worked cotton. —B.C.I.R.A.

Thread Counter. H. Rhomberg. *Melliand's Textilber*, 1926, **7**, 677.

The steel pointer employed in thread counters of large aperture is replaced by a glass prism carrying a very fine scratch on its under side. The scratch is so fine that under the magnifying glass it appears finer than the finest silk thread, and as it is in contact with the fabric there is no error of observation. The measuring length is 50 mms. and the reversible rule carries scales for English, Vienna, and Paris inches. On account of the small distance between the glass prism and the scale, slight errors of observation can arise in covering the prism scratch with the scale scratch, but these are avoided by looking obliquely through the magnifying glass when total reflection causes the two scratches to appear side by side and they can be accurately covered. Provided with a micrometer screw the instrument is also suitable for accurately measuring lengths up to 50 mms. —B.C.I.R.A.

Yarn: Breaking Load Irregularity. W. Töpert. *Melliand's Textilber.*, 1926, **7**, 598-600, and 679-680.

The author explains the discrepancies observed by Lange, and discusses at length the calculation of the regularity of spun yarns. —B.C.I.R.A.

Irregularity. H. Sommer. *Melliand's Textilber.*, 1926, **7**, 759-761.

A table is given of the mean deviations, expressed as a percentage of the mean, of tensile strength tests of yarns composed of artificial silk, natural silk, cotton and bast fibres (flax, hemp, and jute). Irregularity increases in this order. The values for average cotton yarns vary between 5 and 12, while those for corresponding bast yarns vary between 12 and 20. —L.I.R.A.

Hosiery Yarn: Testing; and Gassed Cotton Hair: Appearance. F. Pichler. *Melliand's Textilber.*, 1926, **7**, 761-764.

The dangers of not testing hosiery yarn to determine whether it conforms to specification are illustrated by reference to a 2/60's hosiery yarn which was supposed to be combed and gassed, but which gave an unsatisfactory product. On examining under the microscope it was found that one of the yarns was satisfactorily combed and gassed, but the other was full of thick

places due to uncombed tangles of hairs. Photomicrographs showing the characteristics of combed and gassed yarns, and portions of the satisfactory and faulty hosiery fabric are reproduced. —B.C.I.R.A.

Staple Diagrams: Application. T. Bühler. *Melliand's Textilber.*, 1926, **7**, 662, 737-739, 821-823.

The advantages of accurate staple diagrams as opposed to the method of judging by hand-pulled staples in the marketing of raw cotton are emphasised, and the objection to the expenditure of time in the preparation of diagrams is shown to be invalid. A method of interpreting staple diagrams is explained. —B.C.I.R.A.

Textile Fabrics: Specific Volume and Wearing Test. A. Rosenzweig. *Melliand's Textilber.*, 1926, **7**, 760-761, 842-843.

The specific weight of textile materials is a conception of theoretical value only since it involves the ideal air-free state. The "real volume weight" involving the air-permeated state is the factor of practical importance. For convenience, *V* the "real volume weight" is defined as the weight in grams of 1 cu. dcm., i.e., of 1 sq. metre of 1 mm. thickness. The smaller the value of *V* for a fabric the greater the protection afforded by the fabric against cold and heat. The factor is also of value in detecting admixture of inferior fibre, changes in textile materials by heavy dyeing, filling, &c., *V* being greater for the modified than for the pure product. Such admixture or modification can also be detected by changes in the durability of fabrics, the value being less for the modified product. The durability is accurately measured by the "Solidometer," details of which are not given but which measures the time taken to rub a hole in a fabric under given conditions of pressure and speed, the results being expressed in comparison with the value for the worst known sample of silk taffeta which is designated 1. Some examples of the results obtained are discussed. *A*, the weight in grams of 1 sq. m., *V*, the weight in grams of 1 sq. m. of 1 mm. thickness, and *D*, the durability are given as follows for four cotton fabrics. The best results were obtained for a batiste, A22, V250, and D4,000. A zephyr of established reputation gave A110, V390, and D1,450, whilst an imitation recommended as "cheaper and just as good" gave A125, V500, and D400. A lustrous, mercerised five-end sateen gave A60, V335, and D1,830.—B.C.I.R.A.

Aktivin: Application. E. Jungmichl and J. Hackl. *Melliand's Textilber.*, 1926, **7**, 850-851.

Following the work of Noll on the use of sodium paratoluene-sulphochloramide for the estimation of sulphur dioxide in bisulphite liquor, the authors have used the substance instead of iodine for the evaluation of Rongalite compounds. The titration is made with a N/10 solution of Aktivin, using potassium iodide-starch solution as indicator. Consistent results, agreeing well with those of other methods, are obtained. Aktivin solutions are sensitive to light and must be stored in blackened bottles. In preparing the solution it is sufficient to filter a solution of the commercial product. The cost per litre of Aktivin solution is only 1/40 that of iodine. —B.C.I.R.A.

Naphthols: Differentiation. F. Lewisch. *Melliand's Textilber.*, 1926, **7**, 863.

A small piece of bleached cotton and 10 ccs. of concentrated sulphuric acid are added to 0·1 g. of the naphthol in a test tube. If α-naphthol is present the colour of the solution is carmine, whilst β-naphthol gives a brown colour. These colours change with time to red-violet and by red-brown to blue-green respectively. At the end of one hour the colours are quite distinct and typical, being deep red-violet in the presence of α-naphthol and pure blue-green in the presence of β-naphthol. The red and brown colours which first appear suffice, after some practice, for the differentiation of the naphthols, and the difference is emphasised by diluting the solutions to 5 vols; when the α-naphthol gives a pale violet and the β-compound a pale green. The reaction is applicable to commercial products, but the detection of small amounts of the α- in the β-compound, or *vice versa*, is either impossible or very uncertain. Larger quantities of β-napththol cause the red-violet solution of the α-product to become more murky, whilst in the reverse instance the blue-green of the β-product becomes more blue. Detection may be possible if solutions of the pure products are available for comparison. —B.C.I.R.A.

Sulphur: Micro-determination. E. Eigenberger. *Chem. Abstr.*, 1926, **20**, 2629-2630 (from *Z. Anal. Chem.*, 1926, **68**, 220-231).

By the addition of aqueous sols to the solution, the filtration of barium sulphate is aided. By the use of a suitable celluloid sol prepared in the way described it is possible to replace the expensive Neubauer crucibles necessary for Pregl's method by porcelain filtering crucibles. Complete directions are given.—B.C.I.R.A.

Gas Analysis; Solution of Common Salt as a Confining Liquid for——. H. Tropsch. *Brit. Chem. Abs.*, B., 1926, 427 (from *Z. Angew. Chem.*, 1926, **39**, 401).

The addition of a small amount of sulphuric acid to solutions of salt used as a confining liquid for gas analysis makes no appreciable difference to the solubility of carbon dioxide therein, but serves to neutralise traces of alkaline absorption liquids with which it becomes contaminated and which otherwise would cause

appreciable absorption of carbon dioxide. If the acidified solution is saturated with carbon dioxide and then left for some time exposed to the air, the amount of carbon dioxide it will subsequently absorb from gases containing relatively high proportion of that constituent is inappreciable. To detect readily any change of reaction of the solution the addition of a few drops of phenolphthalein is recommended.
—L.I.R.A.

Hydrogen-ion Meter. A. Hock. *Z. Angew. Chem.*, 1926, **39**, 646-651.

A detailed description is given of a new apparatus for the electrometric measurement of H-ion concentration by the quinhydrone method. The apparatus is so constructed that the results are read directly in milli-volts, and a circular metal scale is described which enables the corresponding *p*H values to be determined without calculation. The reverse side of the disc provides a similar scale for the platinum-hydrogen method. —B.C.I.R.A.

Soap: Swelling. E. L. Lederer. *Z. Angew. Chem.*, 1926, **39**, 690.

The heat of swelling of soap calculated from Katz's swelling formula is in good agreement with that found experimentally; the very low figures obtained may be due to the fact that soap is capable of swelling indefinitely. There remains unexplained, however, the earlier observed phenomenon of the strong self-heating of soaps which occurs if soaps dried to different degrees are stored in contact. The author discusses the swelling constant K, designated by him "permanation," that is, that quantity of liquid which on de-swelling travels across unit area of cross-section in unit time at a concentration difference of unity per unit length, and which is proportional to the total pressure exerted on the swelling liquid. This can either be calculated as the sum of an osmotic pressure plus a supplementary pressure, or better, be regarded as directly proportional to the degree of swelling. K depends not on absolute temperature but rather on Centigrade temperature. This may be explained possibly by the fact that free motion of the water molecules on freezing ceases just below zero. Of special interest is the strict dependence of permanation on the physical pre-history of the soap, so much so that rapidly crystallised soaps have a considerably smaller permanation than those which are crystallised slowly in large forms.
—B.C.I.R.A.

Cotton: Hair Weight per Centimetre and Identification. W. E. Morton. *J. Text. Inst.*, 1926, **17**, T537-T552.

Determination of Twist in Single Woollen Yarns. W. J. Hall. *J. Text. Inst.*, **16**, T359-T362.

Nature of Solutions of Cellulose in Cuprammonium Hydroxide. S. M. Neale. *J. Text. Inst.*, **16**, T363-T369.

Absorption of Methylene Blue from Buffered Solutions. D. A. Clibbens and A. Geake. *J. Text. Inst.*, **17**, T127-T144.

Gravimetric Method for Investigation of the Variation and Levelness of Yarn. S. G. Barker. *J. Text. Inst.*, **17**, T259-T263.

Tensile Tests for Cotton Yarns. (i.) Survey of Current Tests. E. Midgley and F. T. Peirce. *J. Text. Inst.*, **17**, T305-T316.

(ii.) Ballistic Test for Work of Rupture. E. Midgley and F. T. Peirce. *J. Text. Inst.*, **17**, T317-T329.

(iii.) Rate of Loading. E. Midgley and F. T. Peirce. *J. Text. Inst.*, **17**. T330-T341.

(iv.) Dynamics of Some Testing Instruments. F. T. Peirce. *J. Text. Inst.*, **17**, T342-T354.

(v.) The Weakest Link. F. T. Peirce. *J. Text. Inst.*, **17**, T355-T368.

Sulphur Content of Wool. (i.) Inherent Variations According to the Type of Wool. J. Barritt and A. T. King. *J. Text. Inst.*, **17**, T386-T395.

PATENTS

Thread Counter. G. H. Rosenstein, East 99th Street, New York, U.S.A. E.P. 251,911.

A device for use in counting threads in fabrics comprises a box having a ground glass window, an electric lamp beneath the window, a chamber for a battery, and a chamber for the counting apparatus which, when in use, is held by a clip on the top of the box. The apparatus is pivoted and has a bevelled and graduated edge which rests on the fabric positioned above the window. A pointer on a carriage traversed by a screw is moved over the fabric, and the number of threads passed over between the divisions of the graduated edge is counted. A magnifying glass is provided.
—B.C.I.R.A.

Yarn Measuring and Marking Device. Howard & Bullough Ltd. and J. Priestley, Accrington. E.P.257,177.

A stamping or marking device for sizing and other machines comprises a revolvable marking roller movable into contact with the material to be marked at predetermined intervals, the moving material effecting rotation of the roller to bring its marking area into contact with the marking liquid, and to cause the roller to be locked in an initial position by a fixed stop.—B.C.I.R.A.

Tubular Fabric Cutting Machine. P. Gardner, New York. E.P.257,179.

A machine for cutting tubular fabric into bias strip has a vertical mandrel with fixed portions and adjustable parts which are moved to deal with fabric of different

diameters by a screw gear actuated from a hand wheel. The fabric is fed spirally over the mandrel by rollers within the mandrel driven by gearing from a motor. These rollers co-operate with rollers outside the mandrel, mounted in adjustable spring-urged bifurcated arms, and the rollers within the mandrel are set at 45° to the axis of the mandrel. A cutting disc, preferably of emery, is driven by a motor carried on an arm supported on a rod. On either side of the cutting disc is a spring-urged roller co-operating with a driven roller grooved to accommodate the cutting disc. —B.C.I.R.A.

Fluid Viscosity Control Mechanism. J. P. Leask and S. T. Warner, New York, U.S.A. E.P.257,352.

The viscosity of a fluid is controlled by varying the temperature of the fluid and regulating the variation of temperature by the viscosity of the fluid itself. A fluid tank is provided with a heater supplied with a heating medium through a pipe and valve which may be hand-controlled or controlled automatically by pressure. A pump forces liquid from the tank through a pipe to a place where the fluid is in use. A second pipe having a double constriction is connected to the first pipe on the discharge side of the pump and leads back to the tank. Pressure gauges are placed on opposite sides of the lower constriction. From between the constriction a branch pipe leads to the pressure regulator. The greater the viscosity, the greater the difference of pressure on either side of the constriction, and consequently this pressure difference may be made to control the valve in such manner that the greater the viscosity, the larger amount of heating medium is passed, the effect being to reduce the viscosity. A modification is described. —B.C.I.R.A.

Fibre Tensile Testing Apparatus. Metallbearbeitung Ges., Ettlingen, Germany. E.P.257,634.

In apparatus for testing fibres loading is effected by allowing a weight of chain or cord, which chain is wound or unwound on a drum, to act upon a scale beam, the elongation of the fibre being compensated and indicated by the movements of one of the clamps. The scale beam is pivoted on a knife edge and has suspended from one arm a clamp securing the upper end of a fibre specimen, the lower end of which is secured by a clamp carried by a screwed rod which is slid vertically without rotation by a nut formed in one with a drum adapted to be turned by a cord passing to a weight. The drum is normally acted upon by a brake. The other arm of the beam is acted upon by a weight of chain wound on or off a drum. Upon the scale beam moving from normal, an electrical contact is made releasing the brake and allowing the drum to turn and the rod to move down and take up the elongation of the specimen. The chain is passed round pulleys to a recording pen which marks on a drum in one with the drum round which the chord passes. The rotation of the recording drum corresponds to elongation of the specimen. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

256,273. I.G. Farbenindustrie Akt. Ges. Protecting wool against bacteria.

256,898. F. J. Bisbee. Filter presses.

7—BUILDING AND POWER

(A)—Construction of Buildings

Building for "Cotton Standards," U.S.A. I. D. Foos. *Text. World*, 1926, **70**, 457.

The new building of the U.S. Department of Agriculture devoted to the preparation of cotton and wool standards is described. Daylight illumination of the laboratories is secured by sky lights 75 feet long with a southern exposure. Special equipment is provided for conditioning tests. It is stated that cotton standards are being prepared and distributed on a scale of ten thousand boxes a year. —B.C.I.R.A.

Concrete Floor: Treatment. S. Schmidt. *Chem. Zentr.*, 1926, **ii**, 1324 (from *Z. Ges. Text. Ind.*, 1926, **29**, 399-401.

The use of "Tuturol," a fluosilicate, for hardening concrete floors of textile mills is recommended; by this means the formation of harmful lime dust is avoided. —B.C.I.R.A.

(C)—Power

Fractional Horse Power Motors. British Thomson-Houston Co. Ltd. *Text. Merc.*, 1926, **75**, 171.

The application of fractional horse-power motors to textile machinery is discussed. The motors described vary from $\frac{1}{8}$-H.P. to $\frac{1}{4}$-H.P. for alternating current, and up to $\frac{1}{2}$-H.P. for direct current. The direct current motors are compound wound and are made for operation on circuits of any standard pressure between 50 and 250 volts. The mean speed is 1,725 r.p.m., but a speed of 1,140 r.p.m. is available for motors of the $\frac{1}{6}$-H.P. size. The motors can be supplied for rotation in either direction or in both directions, as well as for variable speed. The alternating current motors are of the split-phase type, a centrifugal switch being incorporated so that the starting winding is automatically cut out as soon as the running speed is reached. The motors are supplied for circuits of standard pressures between 100 and 250 volts, 25 to 100 cycles, the 25 and 50 cycle motors being designed to run at 1,425 r.p.m., and those for operation on circuits of other frequencies at the nearest possible speed to this.—B.C.I.R.A.

Textile Machinery: Power Consumption. F. S. Root. *Text. World*, 1926, **70**, 71 and 755.

Data sheets are reproduced showing the power required to operate fringe making,

embroidery, and lace machinery, and carpet and rug looms. —B.C.I.R.A.

Knitting Machinery: Power Consumption. F. S. Root. *Text. World*, 1926, **70**, 1863.

Data sheets showing the power requirements of two small and one large knitting plants are reproduced. —B.C.I.R.A.

Ruths Steam Accumulator. C. L. Hubbard. *Text. World*, 1926, **70**, 1303-1306.

The accumulator furnishes a simple method of equalising the load on boilers and storing the surplus exhaust during periods of light demand, to be given out again when needed. A detailed description is given of the accumulator, and its application in textile mills is discussed. It is stated that in general the capacity of a plant may be increased by 30% or more, and fuel savings of 10%-30% have been realised in many plants. —B.C.I.R.A.

Two-speed Motor Driving Clutch. J. Limbrunner. *Text. World*, 1926, **70**, 199.

A two-speed motor drive is described, designed to overcome any difficulty in starting a chain-driven machine after a few days' stoppage, or to operate the machine at a lower speed to handle certain material. —B.C.I.R.A.

Textile Machinery: Power Consumption. F. S. Root. *Text. World*, 1926, **69**, 3801.

Data sheets showing the power required in embroidery and lace manufacture are reproduced. —B.C.I.R.A.

Boiler Feed Water: Purification. A. Splittgerber. *Z. Angew. Chem.*, 1926, **39**, 1340-1345.

The author calls attention to the necessity for simple criteria for the supervision of boiler water purification systems and deals individually with the methods in use for boiler feed water purification by softening and by evaporation. Requirements in chemical composition of the purified water in relation to boiler corrosion are dealt with, and the more recent views on the special role of caustic soda are discussed. Information follows on the damage caused by dissolved gases in the feed water and their removal, on the carry-over of salts by the steam, and on the properties of condenser water. —B.C.I.R.A.

Bergmann-Nu Loom Drive. P. Beckers. *Melliand's Textilber.*, 1926, **7**, 826-827.

The drive enables the number of revolutions of a loom to be changed quickly and easily to that which is the optimum for the cloth being woven. Essentially, the picking mechanism is separated from the rest of the loom, and the two parts are driven by a combined drive from a single motor or by two separate motors, so that the strength of the pick remains constant through any change in the number of revolutions of the loom. Means are also provided for maintaining a constant beat-up by simultaneously moving the slay nearer to or away from the fell of the cloth as the number of revolutions of the loom is altered. —B.C.I.R.A.

Boiler Plant. F. Urbanczyk. *Melliand's Textilber.*, 1926, **7**, 721-724.

An economical system of power and steam production as applied at small cost in a cloth factory is described. —B.C.I.R.A.

Loom Motors: Application. A. F. Rodger. *Text. Rec.*, 1926, **44**, No. 522, p.p. 90-92, &c.

It is shown that although the initial capital outlay is greater for the individual than for the group system of electric driving, the greater return relative to the capital expended is obtained from the individual drive. With the possible exception of a few special types, the production of counter-shaft-driven looms can be materially increased by individual electric driving, and most of all by the gear drive. Two concrete examples are quoted, a comparison of which demonstrates the superiority of the individual over the group drive. —B.C.I.R.A.

Chlorine Gas Treatment for Cooling-water. *Text. Rec.*, 1926, **44**, No. 522, p. 89.

A handbook entitled "Water Sterilisation by Gaseous Chlorine" has been issued by the Paterson Engineering Co. Ltd., Windsor House, Kingsway, W.C.2, describing the use of their "Chloronome" apparatus for the continuous addition of a very small measured quantity of chlorine gas to water. This has a useful application to cooling-water for preventing the growth of a slimy deposit of vegetable organisms on the inside of the condenser tubes. The maintenance of the highest possible vacuum is thus facilitated, a very important consideration for steam turbines. —L.I.R.A.

Steam Turbine Drive: Application. *Times Tr. and Eng. Supp.*, 1926, **17**, 263.

It is stated that there has recently been a distinct movement in favour of the steam turbine for mill drives on grounds of efficiency, and of economy over electric drives. An installation at Rishton Victoria Spinning Mill is described. —B.C.I.R.A.

P.I.V. Variable Speed Gear. *Times Tr. and Eng. Supp.*, 1926, **19**, 62.

Variable speed gears suitable for textile machinery are discussed. A new type known as the P.I.V. (Positively Infinitely Variable) gear consists in principle in the use of a short chain of special construction operating between two expanding pulleys of the opposite conical disc type mounted on shafts which need be distant only a few inches from one another. The inner working faces of the two expanding pulleys have alternate ribs and grooves, which radiate from the centre, forming teeth which engage with the chain. To alter the speed ratio between the two shafts, the two

halves of each of the pulleys are moved a very small distance along the shafts. As soon as the two halves of one pulley are brought together, the chain being of fixed width must rise automatically in the "V," thus giving in effect a pulley of larger diameter. When the second pulley is widened out to a corresponding extent the chain is allowed to fall in the "V," giving the equivalent of a smaller diameter. —B.C.I.R.A.

(D)—LUBRICATION

Spindles: Lubrication. W. Scott-Taggart. *Text. Rec.*, 1926, **44**, No. 519, p. 47.
A short general article. —B.C.I.R.A.

(F)—LIGHTING

Lighting of Textile Mills. *Text. Merc.*, 1926, **75**, 423.
A description is given of the Keith system of lighting, which has proved to be efficient in a long series of installations erected in many textile mills. The system is adapted to the ordinary town supply of gas; the pressure, however, is slightly increased by means of the Keith Rotary Compressor. Existing gas piping can be used, but the lighting points can be rearranged if necessary. The Keith inverted burners are recommended for the actual lighting, these being specially constructed for use with this high-pressure system. The illuminating power is intensified about four times that of the ordinary incandescent gas burners or about 20 times that of flat flame burners. The Keith textile lamp is also recommended. —L.I.R.A.

Textile Mills: Lighting. *Text. Merc.*, 1926, **75**, 379-380.
The efficiency of electric lamps of various types, and the scientific distribution of light are discussed. Light distribution curves are given for the dispersive type, the focussing-concentrating type and the local type of Mazdalux reflector, and for the "Glassteel" diffuser. —B.C.I.R.A.

Mill Windows: Shading. (1) W. C. Randall and A. J. Martin. (2) H. H. Higbie. *Text. World*, 1926, **70**, 1883.
The accumulation of dirt on window panes has a direct retarding effect on production. Experiments have shown that after a period of four months with windows uncleaned, the amount of light which they could transmit was only 25% to 50% of that for clean windows. The rate of decrease in transmitting power was greatest when the windows had just been cleaned. About 75% of the decrease in transmitting power was due to dirt on the inside of the window. The type of glass used made comparatively little difference in the amount of dirt collected. Where cleaning is only done once a year it should be done in the autumn so as to let in the maximum light during the winter, and the insides of windows should be frequently cleaned with a damp cloth. Experiments on the control of natural illumination indicate that control of light by means of Venetian blinds is better than control by shades covering the lower sash, which is itself better than control by shades covering the upper sash. —B.C.I.R.A.

Cotton Mill: Lighting. K. M. Reid. *Text. World*, 1926, **69**, 3797 &c.
Suitable lighting layouts for the different departments of cotton mills are illustrated and discussed. —B.C.I.R.A.

Daylight Filter. H. Naumann. *Z. Wiss. Phot.*, 1925, **23**, 303-319.
The density or absorption of a filter designed to convert the light from a metal filament lamp to daylight is calculated for several wave lengths from Plank's radiation formula, black body radiation being assumed. Toluidine-Blue is especially suitable as a filter, while as absorbers of shorter rays the following can be used—Methylene Blue, Crystal Violet, Filter Violet, Fast Red D, Rapid Filter Red I, Orange II, and Tartrazine. By suitable choice of dyes the absorption curve may be made to approximate to the theoretical one, and a receipt is given for use with an Osram pointolite tungsten lamp. —B.C.I.R.A.

Light: Dispersion. G. P. Woronkov and G. I. Pokrovski. *Z. Physik*, 1926, **35**, 633-641.
A method of measuring the intensity of the light scattered in different directions from an optically inhomogeneous material is described. Empirical laws are established connecting the intensity of the scattered light, the angle of dispersion, and the optical properties of the substance concerned, and are in agreement with observed results. These empirical laws admit of a theoretical interpretation leading to the assumption that the mean length of path followed in the material by a ray is proportional to the angle of dispersion of this ray from the initial direction. Paper is among the materials tested.—B.C.I.R.A.

Light: Diffuse Reflection. G. I. Pokrovski. *Z. Physik*, 1926, **35**, 390-393.
A new empirical formula for the surface brightness of a vertically illuminated surface of magnesium oxide is proposed. There is good agreement in special cases between the new formula and the earlier results obtained by Hemming and Heuser. The results point to the possibility that the values obtained depend on the method of preparing the magnesium oxide film. —B.C.I.R.A.

Heterochromatic Photometry. W. Ewald. *Z. Physik*, 1925, **33**, 333-334.
A proposed method of heterochromatic photometry is described. If it be desired to measure a green light by comparison with a white standard, a standardised lamp and filter giving the complementary red light is caused to illuminate the side of

the photometer disc illuminated by the unknown green. The proportion of the two colours is adjusted to give a match with the standard white, and the comparison is then homochromatic.

—B.C.I.R.A.

Heterochromatic Photometry. J. Flügge and W. Ewald. *Z. Physik*, 1925, **33**, 325-332.

The author describes a method of heterochromatic photometry by the use of photographic plates of known gamma and known spectral sensitivity exposed through neutral wedges to give regions of equal blackening. —B.C.I.R.A.

Light: Depolarisation by Diffuse Reflection. G. P. Woronkov and G. I. Pokrovski. *Z. Physik*, 1925, **33**, 860-869.

The authors deduce expressions for the relative amounts (R) of polarised light obtained when plane-polarised light is diffusely reflected, it being assumed that the part diffused from the interior of the reflector is completely depolarised. When the plane of polarisation is parallel to the reflecting surface, the amount $R\|$ increases continuously with the angle of incidence or reflection; but the proportion $R\perp$ reaches a minimum for a given angle when the plane of polarisation is perpendicular to the reflector. The surfaces tested were magnesia and white and coloured Alexandrite papers. Fair agreement is found between experiment and theory in the case of the paper reflectors: the depolarisation decreases as the absorption increases.

—B.C.I.R.A.

Light: Diffuse Reflection. G. I. Pokrovski. *Z. Physik*, 1925, **32**, 563-568.

The dependence of the coefficient of diffuse light reflection on the angle of incidence of the light was investigated with the following results—For bodies with small absorption powers the coefficient of diffuse reflection can be assumed constant for all angles of incidence. For bodies with greater absorption power the coefficient increases with increasing angle of incidence. A relation between the absorption power of the diffuse reflecting body, its reflecting power, and the angle of incidence of the light is deduced. —B.C.I.R.A.

(H)—Humidification

Aspiration Psychrometer Tables. H. Ebert. *Z. Physik*, 1926, **35**, 689-696.

According to Gramberg's method tables are calculated for the aspiration psychrometer up to 150° (or 130°) which give the humidity of the air in relation to the temperature of the dry thermometer and the psychrometric difference. The calculation is performed for a total pressure of 760 mm., a partial air pressure of 760 mm., and a total pressure of 355 mm. of mercury.

—B.C.I.R.A.

Artificial Silk: Effect of Humidity Changes. See Section Id.

Patents

Humidifying Apparatus. T. Andrew, Stockport. E.P.257,653.

In humidifying apparatus in which liquid is supplied from a cistern to spraying heads, the level in the cistern is controlled by a float member which is adjustably connected to the valve controlling the liquid supply. The outlet from the cistern may be provided with valve means controlling the passage of liquid to the heads and governed by the compressed air of the humidifying system to close the feed to the heads under a fall of pressure.

—B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

Heating—

256,701. J. Bolton and R. Sharples. Steam-heated cylinders.

8—DESIGN

Looped Fabrics: Designing. W. Schmitz. *Melliand's Textilber.*, 1926, **7**, 421-423, 512-515, 672-673, 754, and 838-839.

The formation of various loops is derived from the simple case of the interlocking of three circles, and it is shown how looped fabrics can be "topologically" analysed so as to work back to the fundamental unit, and further, how new looping systems can be designed. It is stated that the author's ideas have been officially introduced into Czecho-Slovakian technical schools. —B.C.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

U.S. Bureau of Agricultural Economics. L. S. Tenney. *Trans. Nat. Assoc. Cotton Mfrs.*, 1925, **118 and 119**, 66-70.

An outline of the work of the Bureau of Agricultural Economics affecting Cotton.

—B.C.I.R.A.

Operatives: Psychology. B. Quiel. *Melliand's Textilber.*, 1926, **7**, 641 and 724-726.

The analysis of works conditions and processes and the application of psychological methods in industry is discussed.

—B.C.I.R.A.

Married Women Operatives: Employment. M. Hirsch. *Melliand's Textilber.*, 1926, **7**, 891-894.

Employment should cease three months before child-birth, should not be more than four hours per day in the fifth and six months, and six hours in the third and fourth months, with two-hour mid-day pauses. Recommendations are made as to the provision of seating accommodation where the occupation demands prolonged standing or movement, of rest rooms, of good canteens with special

catering, of medical supervision and attention and of women doctors as factory superintendence officers with opportunities of observation for research purposes. Workmen's sick-funds should recognise financial obligation before and during confinement. —B.C.I.R.A.

Cotton Trade Forecast for U.S.A. *Text. World*, 1926, **69**, 3155.

The analysis of the Business Research Bureau, New York University, dated 8th May, forecasted a further decline in raw cotton prices. Unfavourable margins between raw cotton and yarn or cloth would justify curtailment of mill operations, thus further tending to stabilise cotton textile prices. The outlook was for a moderate recession in business and mill activity from May to the end of August. —B.C.I.R.A.

Cotton Textiles: Statistics for U.S.A. *Text. World*, 1926, **69**, 3446.

The Department of Commerce now publishes monthly statistics of production, stocks, and unfilled orders for cotton cloths, including sheetings, print cloth, pyjama checks, drills, twills, &c. The statistics are compiled from the weekly and bi-monthly reports of the Cotton Textile Merchants of New York, which is the selling agency for the southern mills and some New England Mills. —B.C.I.R.A.

Cotton Mills Costing Scheme. E. G. Field. *Text. World*, 1926, **69**, 3481-3485.

A normal standard cost plan suitable for cotton mills is described. Its aim is to ascertain the cost of any individual fabric in terms of overhead charges, cost of a standard amount of production from any one operation, and direct labour costs for the machine operatives. —B.C.I.R.A.

Cotton Textiles: Statistics for U.S.A. *Text. World*, 1926, **69**, 3490.

Statistics given in a Harvard Bureau of Business Research Bulletin indicate that approximately 36% of the cotton cloth distributed in the United States in 1924 was sold as piece goods by retailers. The bulletin is a survey of the methods of marketing textiles and includes the sales trends for cotton piece goods and ready-to-wear merchandise from 1911-1925.—B.C.I.R.A.

Selling of Textiles: the Importance of Salesmanship. *Text. Merc.*, 1926, **75**, 451.

It is pointed out in this article that salesmanship is one of the greatest aids to industrial development. The British Textile trade is now in a different position to that held before the war. Foreign competition has steadily increased, and the buyer can obtain his supplies in his own country. A change in the method of salesmanship is necessary, as in Manchester at the present time there is the means to produce the goods, but a slump in the market exists. It is found that the most successful firms in Manchester are those who send travellers with a knowledge of the language and habits of the country to which they go.—L.I.R.A.

The Merchant in the Textile Trade. E. Ramsden. *Text. Merc.*, 1926, **75**, 523.

In a paper given before the Huddersfield Textile Society, the lecturer divides merchanting into three categories—(1) The merchant engaged in the home trade, (2) The merchant selling goods abroad as well as at home, (3) The export merchant. The lecturer believed that the utility of the first two classes cannot be debated, but that different views were sometimes held regarding the third class. The function of a merchant was to sell and finance, and a knowledge of foreign markets was essential to export merchants. The lecturer recognised that in certain cases it was advantageous for the manufacturer to sell direct, but in a large number of cases sales through the merchant would for many reasons be found to be the best and most efficient. —L.I.R.A.

Weaving Shed: Economic Unit. W. Wilkinson. *Text. Merc.*, 1926, **75**, 554-555.

A lecture on Production Costs and Machinery used in the Manufacturing Process, in which greater specialisation in weaving as opposed to mass production is advocated for Lancashire. The establishment of a large number of small, efficient factories, each under the control of an expert who had an active interest in his concern and was able to supervise highly specialised work, might lead to all-round improvements. The small 60 to 100 loom units might be spread over rural areas, where rating and other handicaps are absent. —B.C.I.R.A.

Standardisation in the Textile Trade: Some Aspects of Overseas Trade. A. M. Samuel. *Text. Merc.*, 1926, **75**, 581.

In an address given before the Bradford Textile Society the lecturer emphasised the importance of standardisation. He thought the choice of size and varieties of articles offered for sale to foreign customers was unnecessarily diverse. The tendency to standardise was growing in America and other countries, and should be developed here. Standardisation for the home textile trade would reduce overhead charges and would enable products to be sold more cheaply, thus facilitating the production of greater variety for export. Other countries were showing novelties abroad and reducing the variety of patterns at home. —L.I.R.A.

Cotton Cultivation in Nigeria. W. G. A. Ormsby-Gore. *Text. Merc.*, 1926, **75**, 582-583.

It is maintained that in solving the problem of cotton growing in the tropical and sub-tropical dependencies of the Empire,

transport is as important as such scientific problems as seed selection and methods of production, particularly in view of the present tendency of prices. The effects of a well-planned road system can be seen in Uganda and the Gold Coast. Nigeria is particularly deficient in roads. In Southern Nigeria the rainfall is too high and the forest too dense for development as a cotton-growing country. In the north, conditions are ideal for dealing with cotton. Zaria is the centre of the cotton-growing industry, and cotton of an American type grows well and is of good quality. The rainfall and soil of the area round Sokoto are suitable for the production of cotton of the American type. There are only four ginneries in Northern Nigeria due to the lack of means of transport. The middle belt of Nigeria demands the improvement of the indigenous native cotton. At the present stage Sierra Leone, the Gold Coast and Gambia, must be definitely excluded as possible cotton-growing countries. The opinion is stated that the future of Empire-grown cotton will depend on turning out, in Africa particularly, a type of cotton which is always at least 2d. to 4d. a lb. of lint on American middling. —B.C.I.R.A.

Cotton Cloth: Folding and Packing. Manchester Chamber of Commerce. *Text. Merc.*, 1926, **74**, 604-605.

A standard method of indicating "cuts across" in a roll of cloth has been adopted by representative bodies of weavers and finishers, and consists in pulling out one corner of the cut edge so that it is visible. In folding better-class fabrics it is recommended that the plaited edges should be wrapped over with the end of the cloth for protection in storage or transit.
—B.C.I.R.A.

10—MISCELLANEOUS

"Elzit" Cloth Marking Pen. K. Haase. *Melliand's Textilber.*, 1926, **7**, 840.

For marking gray cloth which is to be subjected to finishing processes, a reservoir pen provided with a spring-held ball instead of a nib writes with a yellow colour which is fast to boiling, scouring, bleaching, and mercerising, fast to covering with all classes of dyes and for all shades from white to black, including aniline black. The colour dries immediately it is put on the fabric so that continuous working is possible without fear of copying off. Wet fabrics can be marked with the colour with equally fast results. A black colour especially useful for bleaching is also available. Ball pen and colours are furnished by the firm of Ernst Loewe, Zittau, Sa. 28.
—B.C.I.R.A.

Smithsonian Institution Textile Museum. I. D. Foos. *Text. World*, 1926, **70**, 307-308.

An account of the educational value of the collections and their use to designers. Working models of machines are also exhibited. —B.C.I.R.A.

Long Draft Mechanism: History. R. E. Naumburg. *Text. World*, 1926, **70**, 317-319.

By means of diagrams it is shown that the principle employing endless bands or aprons in high drafting was present in an English patent granted to Philip Chell in 1823 for "Certain improvements on machinery for drawing, roving, and spinning hemp, flax, and waste silk." —B.C.I.R.A.

Oxy-Acetylene Equipment: Application. *Text. World*, 1926, **70**, 743-744 and 1861-1863.

Oxy-acetylene welding and cutting equipment for textile mills is described and its value for welding proper, cutting, and building up worn or undersized surfaces is emphasised. Some essential points of successful operation are discussed.
—B.C.I.R.A.

Fibre Drafting Systems: Historical. R. E. Naumburg. *Text. World*, 1926, **70**, 1449.

Two early American inventions covering the single endless belt (1868), and double endless belt (1870) types of fibre drawing systems are described. —B.C.I.R.A.

Electrical Refrigerating Unit. F. W. Sturtevant. *Text. World*, 1926, **70**, 1307-1308 and 1873.

The principles of mechanical refrigeration are discussed, an electrical installation intended primarily for cooling drinking water is described, and possible uses of similar installations in textile processes requiring low temperatures, such as diazotisation and mercerisation, and in the preservation of printing pastes, viscose, &c., at low temperatures are indicated.
—B.C.I.R.A.

Artificial Silk: Research. W. F. Edwards. *Text. World*, 1926, **70**, 2005-2006.

It is urged that fundamental research is essential in the artificial silk industry, as only by a better knowledge and control of the physical and chemical properties of the materials at each step of the manufacturing processes can the tensile strength, elasticity, and strength when wet of the fibre be materially increased. Typical problems are outlined, and emphasis is laid on the value of X-ray work.
—B.C.I.R.A.

Cloth Plaiting Machine Compensating Motion. Hacking & Co. Ltd. *Text. Merc.*, 1926, **75**, 261.

In order to compensate for the bulge in cloth when it is folded on the convex table of the plaiting machine, a lag about 4 in. wide is provided in the centre of the table. On commencing to fold the cloth a board running down the centre of the table rises automatically, and automatically

falls slightly as each succeeding fold is laid so that a constant length of fold is ensured. The height which the board can be raised and the time in which it will fall in relation to the table can be varied. The lifting lag can be adjusted to suit various kinds of cloth by means of a thumbscrew and hand-wheel. In a demonstration, pieces of cloth one hundred yards in length produced folds which did not vary ⅛ in. —B.C.I.R.A.

Some Physical and Optical Characteristics of the Stylus-on-Celluloid Method of Recording. W. G. Collins. *Science Abs.*, A., 1926, 1490 (from *Trans. Optical Soc.*, 1925-26, **27**, 215-218).

It is shown that the stylus-on-celluloid record consists of a cylindrical depression forming a minute cylindrical lens, bordered by ridges forming quasi-cylindrical lenses of positive form and beyond these concave cylinders. When viewed with a properly focussed microscope, the record appears as a dark band on a bright ground, and at the centre of the dark band is a fine bright line on which precise measurements can be made. The record is not made by scratching but by plastic deformation. —L.I.R.A.

U.S. Bureau of Standards. G. K. Burgess. *Trans. Nat. Assoc. Cotton Manufacturers*, 1925, **118-119**, pp. 52-66.

An account of the work of the Bureau of Standards relating to the textile industry. —B.C.I.R.A.

Mule Spinners' Cancer: Cause and Control. Report of Home Office Departmental Committee. *Text. Rec.*, 1926, **44**, No. 519, p. 102.

The earliest diagnosed case of scrotal epithelioma in a mule spinner which could be traced occurred in Manchester in 1887. Of 486 deaths in different occupations in the ten years 1911-1920, the cotton spinning victims totalled 100, as compared with 11 among gasworkers, which was the next highest figure. The mortality among spinners is 14 times as great at the ages of 25-35, 60 times as great at 45-55, and 100 times as great at 55-75 as that in the general population, and the incidence of the disease is rapidly increasing. The earliest age at which it has been recognised is 22, and the latest 77 years; it appears specially liable to manifest itself at 35 years, and reaches its maximum at about 55. No evidence could be obtained of a similar incidence among mule spinners in France, Germany, Russia. Poland, and America. The oil used on the mules is cited as the cause of mule spinners' cancer, and the following recommendations are made—(1) The institution of research with a view to finding lubricating oils which are innocuous. (2) The development of a non-splash type of spindle bearing. (3) The prevention of oil-splash from existing mules by some kind of guard. (4) A periodic medical examination of every worker in the mule spinning room who is 30 years of age and over, and to take place at least every four months. (5) Education by the periodic distribution of leaflets. —B.C.I.R.A.

Leicester's Textile Industry: Its Early Story. M. P. Dare. *Text. Rec.*, 1926, **44**, No. 523, 44.

A collection of interesting facts relating to industrial conditions from about 1200-1600. —A.J.H.

Hosiery Machinery: History. M. P. Dare. *Text. Rec.*, 1926, **44**, No. 523, pp. 67-70.

An historical article dealing with the invention of the stocking frame by Lee, improvements by Aston, the 18th century riots against knitting machines, the introduction about 1756 of the rib stitch by Strutt, the rotary frame in 1769, the invention of the latch needle by Townsend, and subsequent developments. —A.J.H.

Coloured Photographs: Preparation and Application. F. Körner. *Melliand's Textilber.*, 1926, **7**, 696-697.

A method of colour photography is described which enables coloured prints almost true to colour, or coloured projections on a white screen to be obtained. Three partial photographs are made, red, green, and blue filters being used. They are then coloured with special "Pinatype" dyes and give, after washing, coloured plates from which prints can be obtained. For the production of cloured pictures on a white screen the partial photographs in the uncoloured state are brought into the Diernhofer projection apparatus, which has only one source of light but several objectives, are correctly adjusted in a slide carrier of high mechanical precision, and three or more colour filters are placed before an equivalent number of objectives, an additive effect being produced on the screen. By suitable selection of the colour filters a rapid succession of coloured effects can be observed until one desirable for textile purposes is obtained, when the colour filters used are noted, the specifications enabling Pinatype prints of the same colours to be prepared for use as patterns. —B.C.I.R.A.

Activin: Antiseptic Properties. R. Fiebelmann. *J. Inst. Brewing*, 1926, **32**, 421 (from *Wochschr. Brau.*, 1926, **43**, 302-306).

A 0·5% solution of activin in water kills *Aspergillus niger* in one hour and a healthy yeast in the same time. A 0·001% solution destroys lactic acid bacteria in 12 hours. —B.C.I.R.A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

256,739. C. H. Baddeley. Material for packing raw wool, tops, and yarns.

ABSTRACTS

LIST OF SECTIONS

1.—FIBRES AND THEIR PRODUCTION
(Including constitution and substance)

(A) Mineral.
(B) Animal.
(C) Vegetable.
(D) Artificial.

2.—CONVERSION OF FIBRES INTO FINISHED YARNS

(A) Preparatory processes.
(B) Spinning and Doubling.
(C) Subsequent processes.
(D) Yarns and Cords.

3.—CONVERSION OF YARNS INTO FABRICS

(A) Preparatory processes.
(B) Sizing.
(C) Weaving.
(D) Knitting.
(E) Lacemaking and Embroidering.
(F) Subsequent processes.
(G) Fabrics.

4.—CHEMICAL AND OTHER PROCESSES

(A) Boiling.
(B) Scouring and Degumming.
(C) Washing.
(D) Milling.
(E) Drying and Conditioning.
(F) Carbonising.
(G) Bleaching.
(H) Mercerising.
(I) Dyeing.
(J) Printing.
(K) Finishing.
(L) Waterproofing.

5.—LAUNDERING AND DRY-CLEANING

6.—ANALYSIS, TESTING, GRADING AND DEFECTS

7.—BUILDING AND POWER

(A) Construction of Buildings.
(B) Fire Prevention.
(C) Power.
(D) Lubrication.
(E) Transport.
(F) Lighting.
(G) Heating.
(H) Humidification.
(I) Ventilation.

8.—DESIGN

9.—COMMERCE, ECONOMICS, LABOUR, ORGANISATION, COSTING &c.

10.—MISCELLANEOUS

PUBLICATIONS ABSTRACTED JANUARY TO DECEMBER, 1926

† Received at the Textile Institute.

Abstracts of Bacteriology.
African Cotton Journal.
Agricultural Journal of Malaya.
Agricultural Gazette, New South Wales.
Agronomie Coloniale, Paris.
†American Dyestuff Reporter.
American Food Journal.
†American Silk Journal.
†Analyst.
Annales de Physique.
Annales de la science agronomique française.
Annali d'igiene (sperimentale), Torino.
Annals of Applied Biology.
Annals of Botany.
Annual Bulletin: Department of Agriculture, Nigeria.
Annual Report: Department of Agriculture, U.S.A.
†Annual Report: Department of Agriculture, Kenya.
†Annual Report: Department of Agriculture, Madras.
†Annual Report: Department of Agriculture, Nyasaland.
†Annual Report: Agric. Experiment Station, Georgia.
†Annual Report: Department of Agriculture, Cyprus.
†Annual Report: Industrial Fatigue Research Board.
†Annual Report: Louisiana Agric. Experiment Station.
Atti della R. Accademia dei Lincei.
Australian Cotton Grower.
†Avenir Textile.

Berichte der Deutschen Botanischen gesellschaft.
Berichte der Deutschen Chemischen gesellschaft.
Biochemical Journal.
Biochemische Zeitschrift.
†Board of Trade Journal.
Bolletino Direccion Estudios Biologicos.
Botanical Abstracts.
Botanisches Zentralblatt.
Brasserie et Malterie.
Brennstoff-Chemie, Essen.
British Journal of Psychology.
Bulletin de l'academie imperiale des sciences de St. Petersburg.
Bulletin Agricole de l'Algerie-Tunisie-Maroc.
Bulletin agricole du Congo Belge, Bruxelles.
Bulletin of the Agric. Experiment Station, Arizona.
Bulletin of Applied Botany and Plant Breeding, St. Petersburg.
Bulletin of the Arkansas Agric. Experiment Station.
Bulletin of the Bureau of Bio-Technology.
Bulletin of Entomological Research.
†Bulletin of the Imperial Institute.
†Bulletin of the Ministry of Agriculture, Egypt.
Bulletin International de l'Academie des sciences de Cracovie.
Bulletin: Lowell Textile School.
Bulletin de l'Institut Egyptien.
†Bulletin of the Minnesota Agric. Experiment Station.
Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew.
†Bulletin of the North Carolina Agri. Experiment Station.
Bulletin of the Oklahoma Agric. Experiment Station.
Bulletin de la Société Chimique de Belgique.
Bulletin de la Société Chimique de France.
†Bulletin de la Société industrielle de Mulhouse.
†Bulletin de la Société industrielle de Rouen.
Bulletin des travaux de la Société de Pharmacie de Bordeaux.
Bulletin: South Dakota Agric. Experiment Station.
Bulletin of the Agric. Experiment Station, Texas.
Bulletins of the Wellcome Tropical Research Laboratories, Khartoum.
†Bulletin of the Wyoming Agric. Experiment Station.
Burma: Mycologists' Report.

†California: Publications of the University.
Canadian Electrical News & Steam Engineering J.
Cellulose Industry, Tokyo.
Cereal Chemistry.
Chemical Abstracts.
Chemical Age, London.
Chemical and Metallurgical Engineering.
†Chemicals (U.S.A.).
Chemie der Zelle und Gewebe.
Chemiker Zeitung.
Chemische Umschau auf dem gebiete der Fette, Oele, Wasche, und Harze.
Chemisches Zentralblatt.
†Chimie et Industrie.
China Weekly Review.
Circular: California Agriculture Experiment Station.
Circular of the Mississippi Agric. Experiment Station.
Circular of the Missouri Agric. Experiment Station.
Circular of the Oregon Agricultural Experiment Station.
Circular of the South Carolina Agric. Experiment Station.
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